WIRED

High Phynance vs. Wall Street

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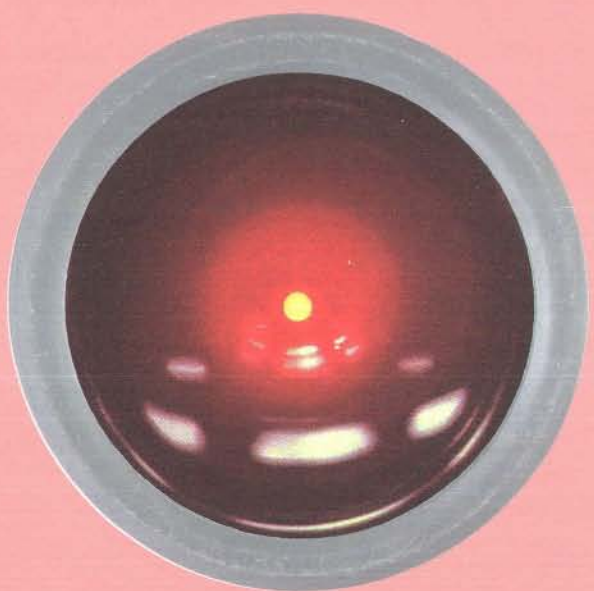

Good afternoon, gentlemen.

I am a HAL 9000 computer.

I became operational at the

HAL plant in Urbana, Illinois,

on the 12th of January, 1997.

My instructor was Dr. Chandra,

and he taught me to sing a song.

If you'd like to hear it, I can

sing it for you. It's called "Daisy."

"Daisy, Daisy, give me your

answer do. I'm half-crazy..."

Why the future of 2001 ain't what it used to be:

Happy Birthday, HAL

AI, space, Clarke – and Kubrick's next odyssey...

January 1997

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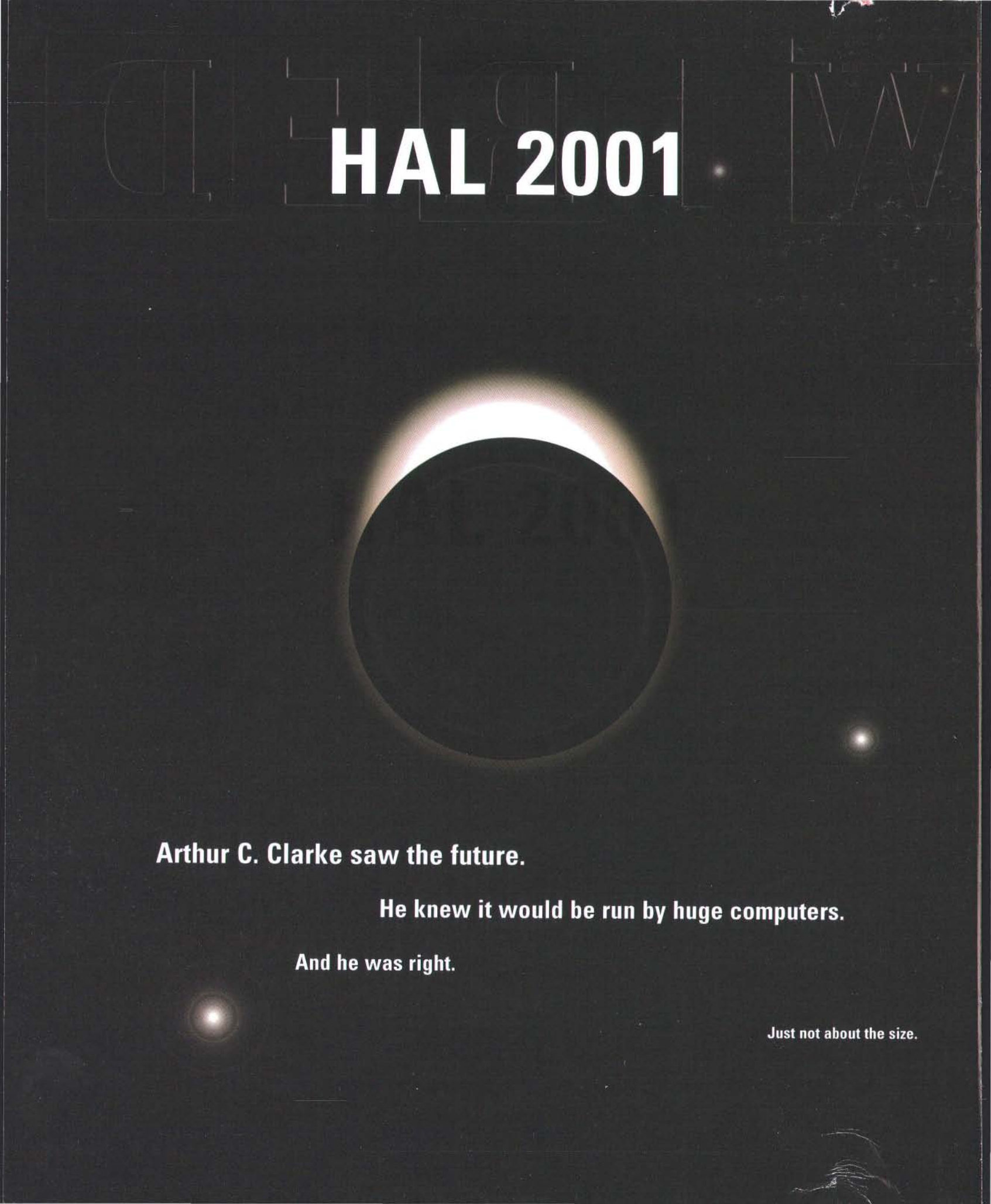
HAL 2001



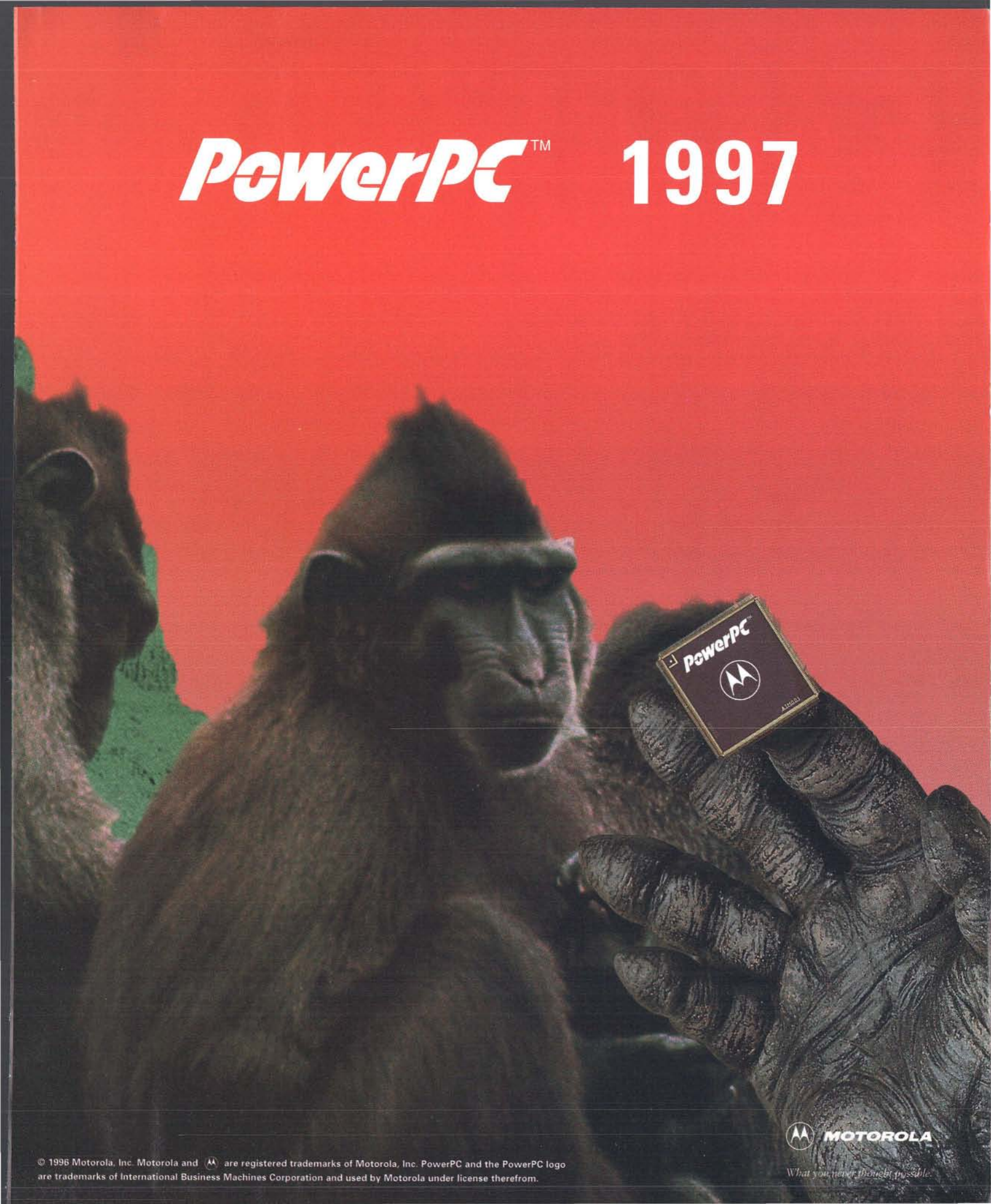
Arthur C. Clarke saw the future.

He knew it would be run by huge computers.

And he was right.

Just not about the size.

PowerPC™ 1997



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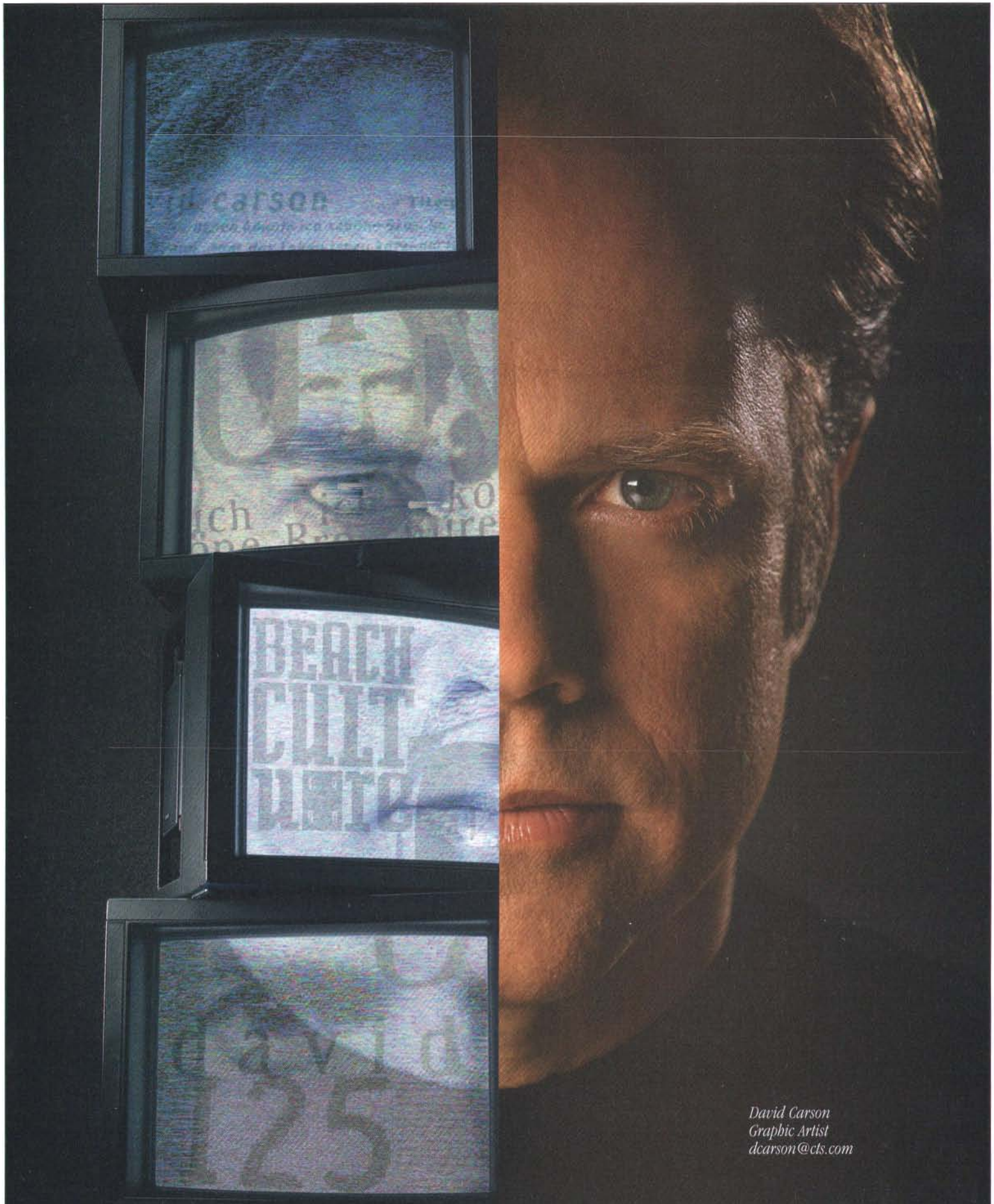

David Carson
Graphic Artist
dcarson@cts.com

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SUDDENLY THERE'S AN EXPLOSION IN YOUR HEAD.

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With words, with movement, with a heart-stopping new power like never before. *You don't know where it came from. Or where it's going.* But you know how it will get there.

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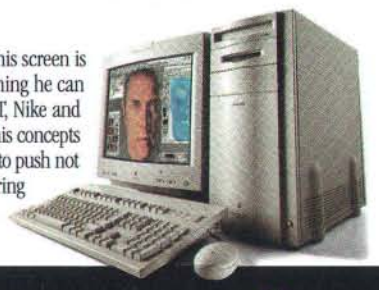
Inspiration happens. In David Carson's case, inspiration happens a lot. Fortunately for David, what he sees on his screen is never very far from what he sees in his mind. Power Macintosh® computers help him explore just about anything he can imagine. His groundbreaking design work for *Surfer* and *Ray Gun* magazines—as well as for clients like AT&T, Nike and Pepsi—confirms it. But the Power Mac™ is also flexible enough to change when David's ideas do. So he can take his concepts and easily reexpress them in new mediums—from film to the Internet. It's the kind of freedom that allows him to push not only the limits of his computer, but the limits of his creativity. Authoring web sites. Manipulating graphics. Altering video. It's never been easier for David to create the work he's known for: the kind that never existed before.



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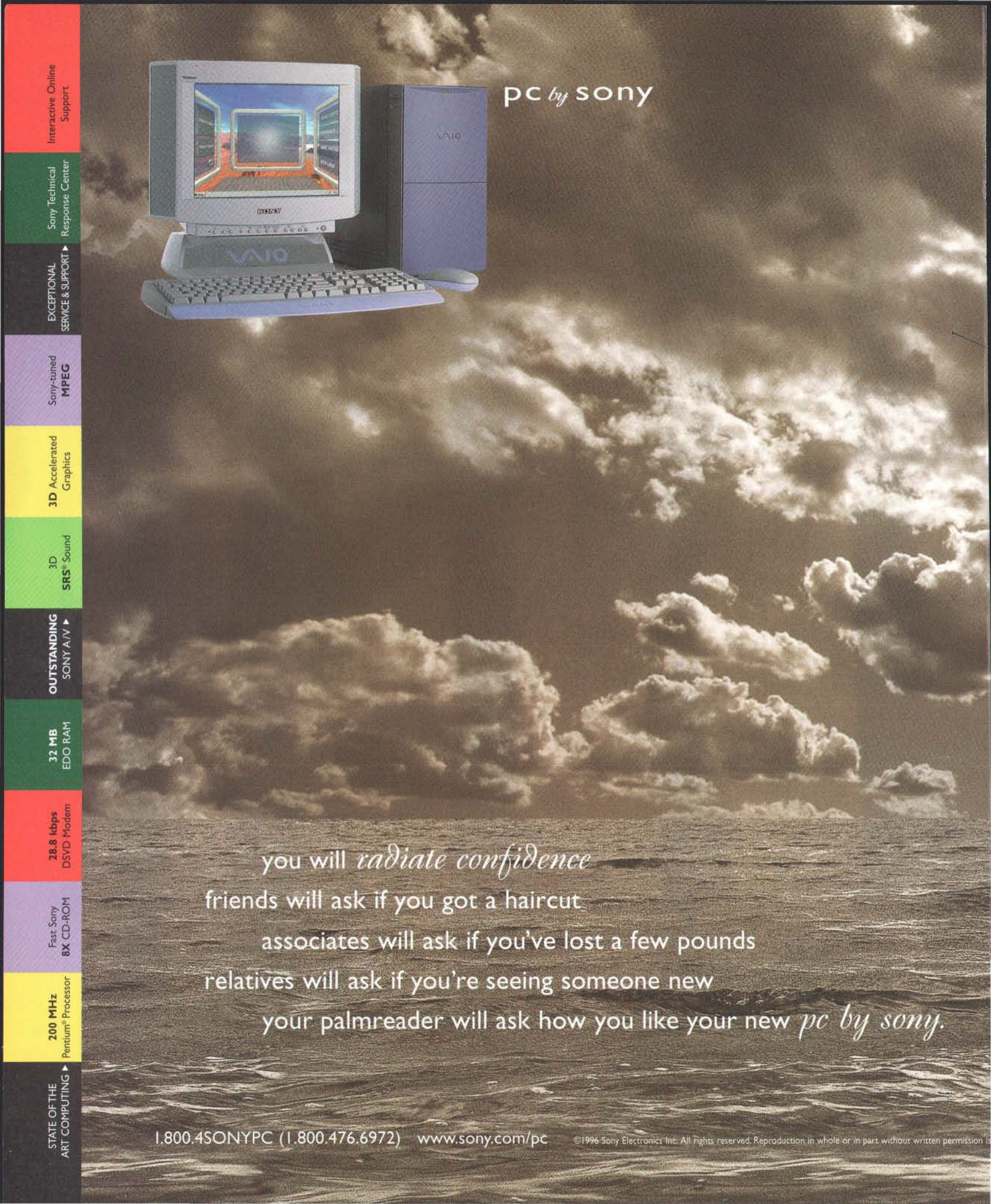
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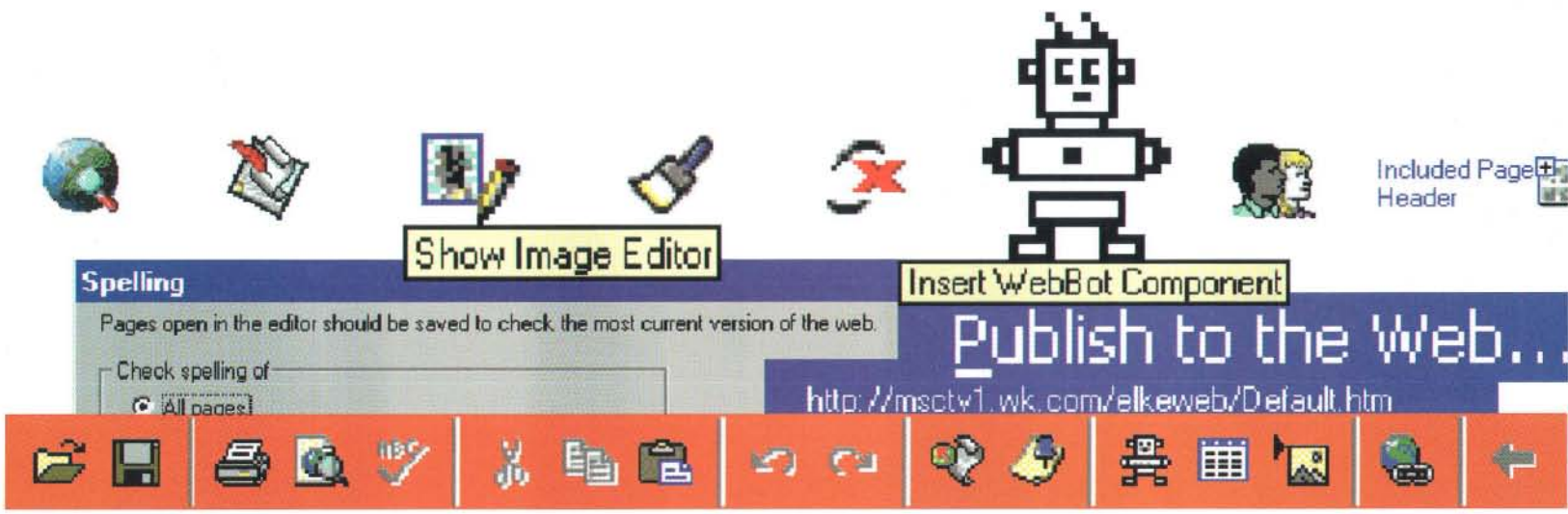

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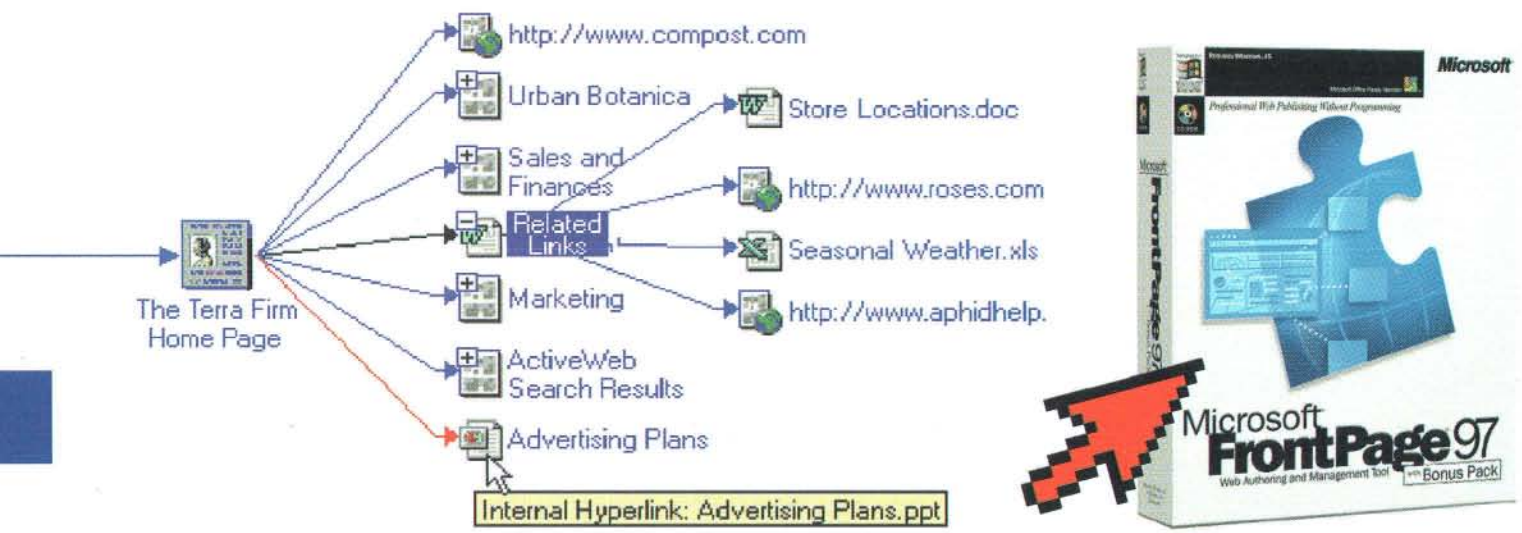

Maybe you're not ready to wrassle computer gibberish to the ground and make it cry uncle. (Or<B>Uncle!</B>, as it more likely would say.) That's okay—the new Microsoft® FrontPage™ 97 Web authoring and management tool has everything any Webmaster needs, and it lets you skip right to the fun stuff. For starters, you can use Web wizards to begin building your site. Create instant hyperlinks. Without a whit of programming know-how, call on WebBot™ components to add interactive features. Spell check across your entire site, instead of page by laborious page.

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Expansion Slots/Drive Bays	5/5 Desktop	5/5 Desktop	5/5 Minitower
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Security Features	Yes	Yes	Yes
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Patricia Steves and an unfortunate Saturn that met the same fate as one of her eggs.

"It even saved our groceries."

"All right, we did lose one egg," admit both Patricia and Roger Steves. But considering the accident they were involved in, they don't seem to mind. You see, while on the way home from the grocery store one afternoon, they were rear-ended by a pickup truck and the front of their Saturn was pushed into the car in front of them. SATURN. Luckily neither Patricia nor her husband was seriously hurt. They did, however, fear the worst for their parcels since the trunk was now "trying very hard to become part of the back seat." So you can imagine their surprise when they discovered that, with the exception of one unlucky egg, their groceries were as unharmed as they were.

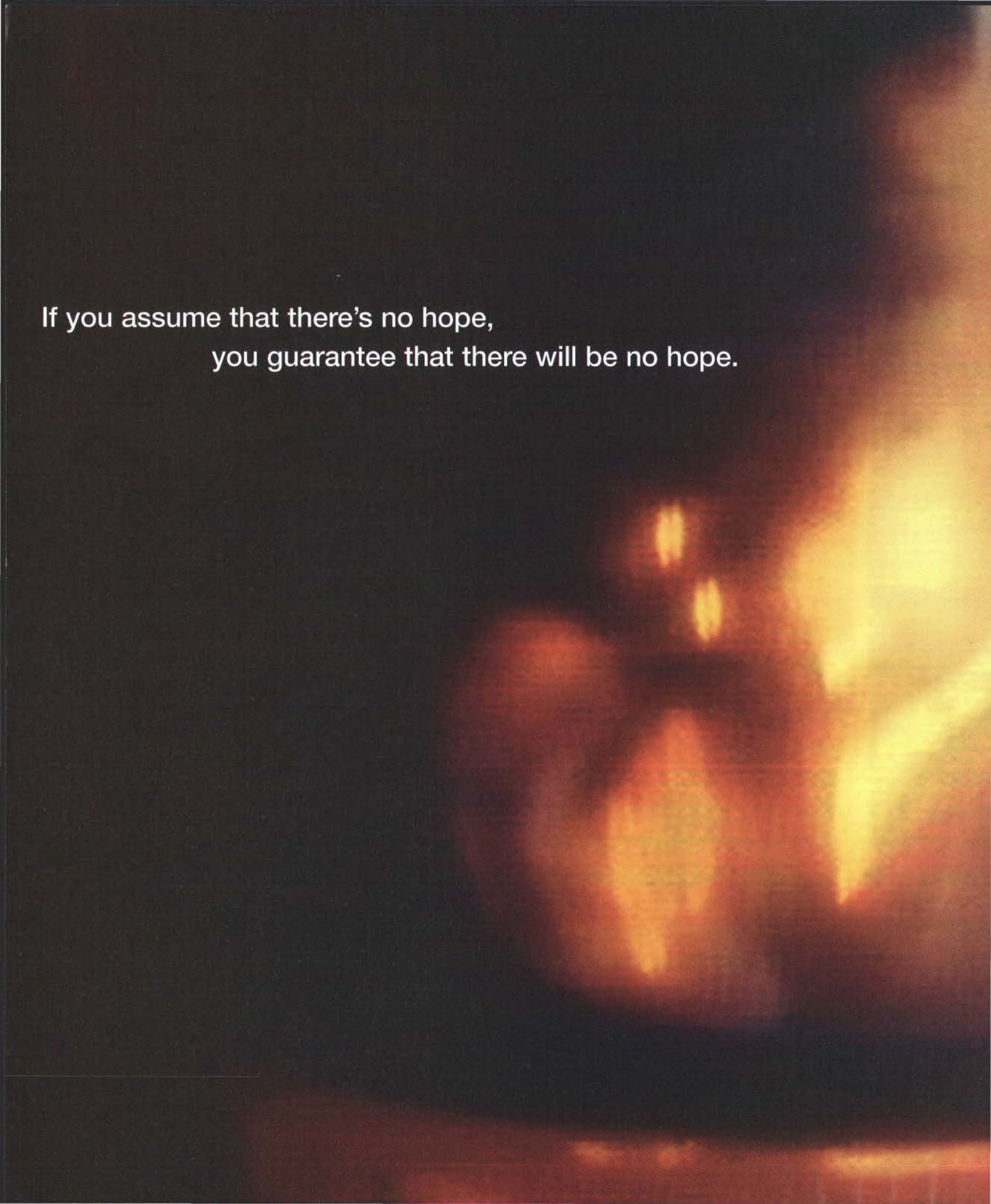
THE 1997 SATURN SL1

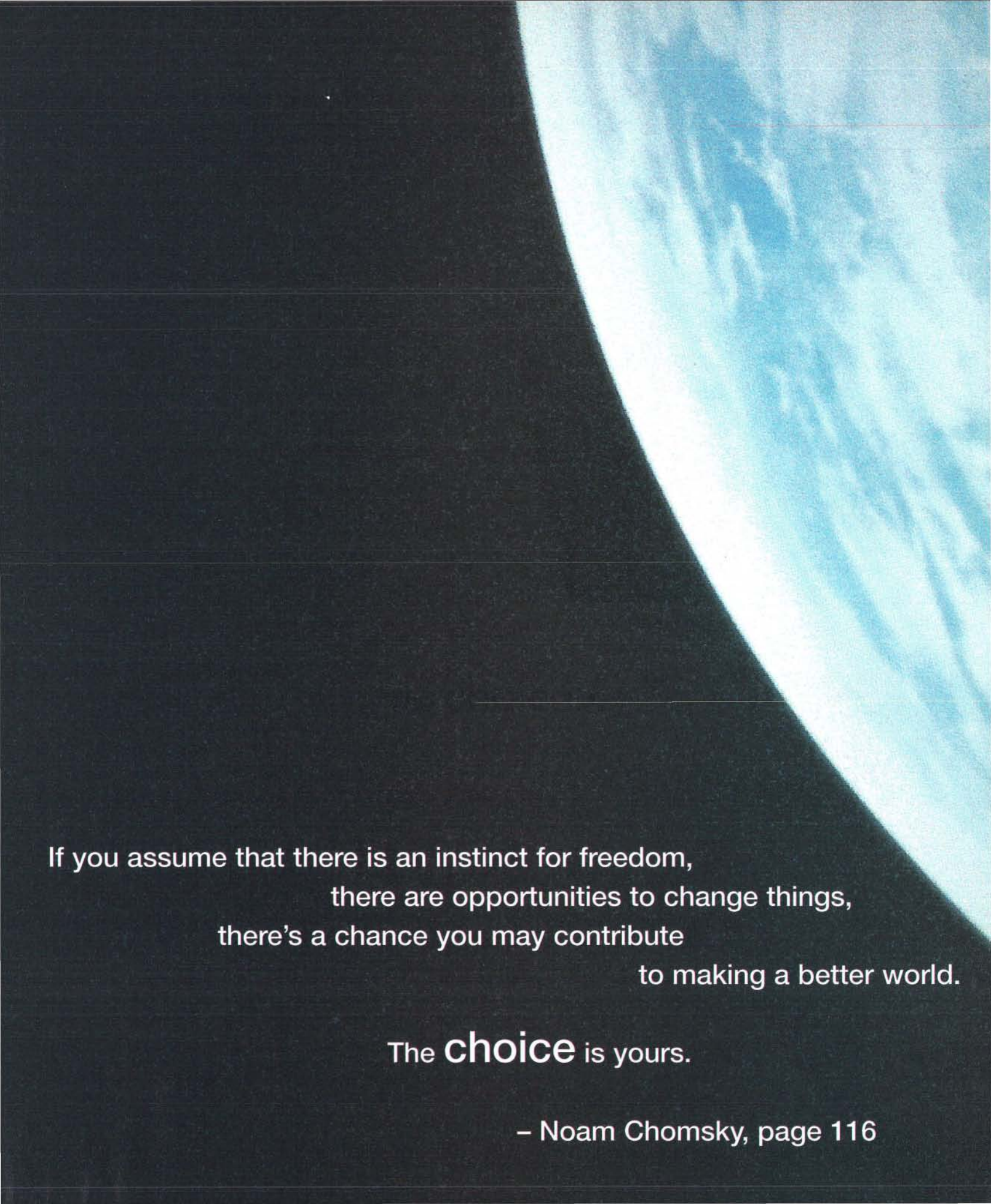
All Saturns are built around a steel spaceframe. When an accident occurs, the front and rear sections begin to crumple and absorb energy from the impact. This helps the passenger compartment maintain its shape and structural integrity. Which, in turn, helps squash the belief that you have to spend $40,000 to feel safe.

PATRICIA STEVES' 11-EGG FRITTATA RECIPE—*Ingredients: 1 cup of diced onion, 1 cup of diced green pepper, 2 cups of diced ham, 11 eggs. Sauté onions and peppers until cooked, mix in ham, divide mixture in half and keep warm. Then beat 6 of the eggs with a fork, stir in half of the filling mixture and season to taste. Pour into preheated omelet pan. Flip into another pan when bottom of the frittata is set. Cook another 1 or 2 minutes. Repeat with other half of ingredients. Serves 6.*

A DIFFERENT KIND *of* COMPANY. A DIFFERENT KIND *of* CAR.

This 1997 Saturn SL1 has an M.S.R.P. of $11,995, including retailer prep and transportation. Of course, the total cost will vary seeing how options are extra, as are things like tax and license. We'd be happy to provide more detail at 1-800-522-5000 or look for us on the Internet at http://www.saturncars.com. *©1996 Saturn Corporation.*


If you assume that there's no hope,
you guarantee that there will be no hope.



If you assume that there is an instinct for freedom,
there are opportunities to change things,
there's a chance you may contribute
to making a better world.

The **choice** is yours.

– Noam Chomsky, page 116

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The Netizen: News You Can Abuse

The Net is doing more for paranoia and conspiracy than anything since J. Edgar Hoover's infamous FBI files. It's the golden age of "secrets." But the truth will out.
By Tom Dowe

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Happy Birthday, HAL

The HAL 9000 – an artificial intelligence that could think, talk, feel, and occasionally go berserk – was supposed to be operational in January 1997. Has anyone seen HAL?
By Simson Garfinkel

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On the Trail of SETI

The truth that NASA dares not speak.
By Dennis Overbye

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Confessions of a Webback

Guillermo Gomez-Pena uses the anonymous, open nature of the Net to turn racism into art.
By Evanthela Schibsted

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Cellular Obsession

What happens when you cut cellular rates to pennies and let any kid have a stripped-down mobile phone? Israel is the world's petri dish. A lot of weird life-forms are sprouting up.
By Sheldon Teitelbaum

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Art House

Designer Alessandro Mendini's surrealist-inspired staircase makes the Groninger Museum as much of a spectacle as the art it displays.
By Anne Speedie

Context

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The Phynancier

Out where mathematics, physics, and finance collide, the enigmatic and hugely successful quant David Shaw is determined to make Wall Street obsolete. By Thomas A. Bass

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Fantastic Voyage

Tracing an angler's encounter with a spiritual fish, photographer Arthur Tress's *Fish Tank Sonata* contrasts environment and artifact with vivid absurdity. By Erica Ackerberg

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Evolution Revolution

Care to reprogram yourself? Customize your kids? Derail evolution? By 2005, the Human Genome Project will have transcribed the entire programming language of human life. By Charles Platt

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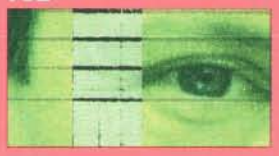

Declaration of Interdependence

According to eco-architect Bill McDonough, failure to protect the environment is intergenerational tyranny, and the key to saving the planet isn't more regulations, but better design. By Vernon Mays

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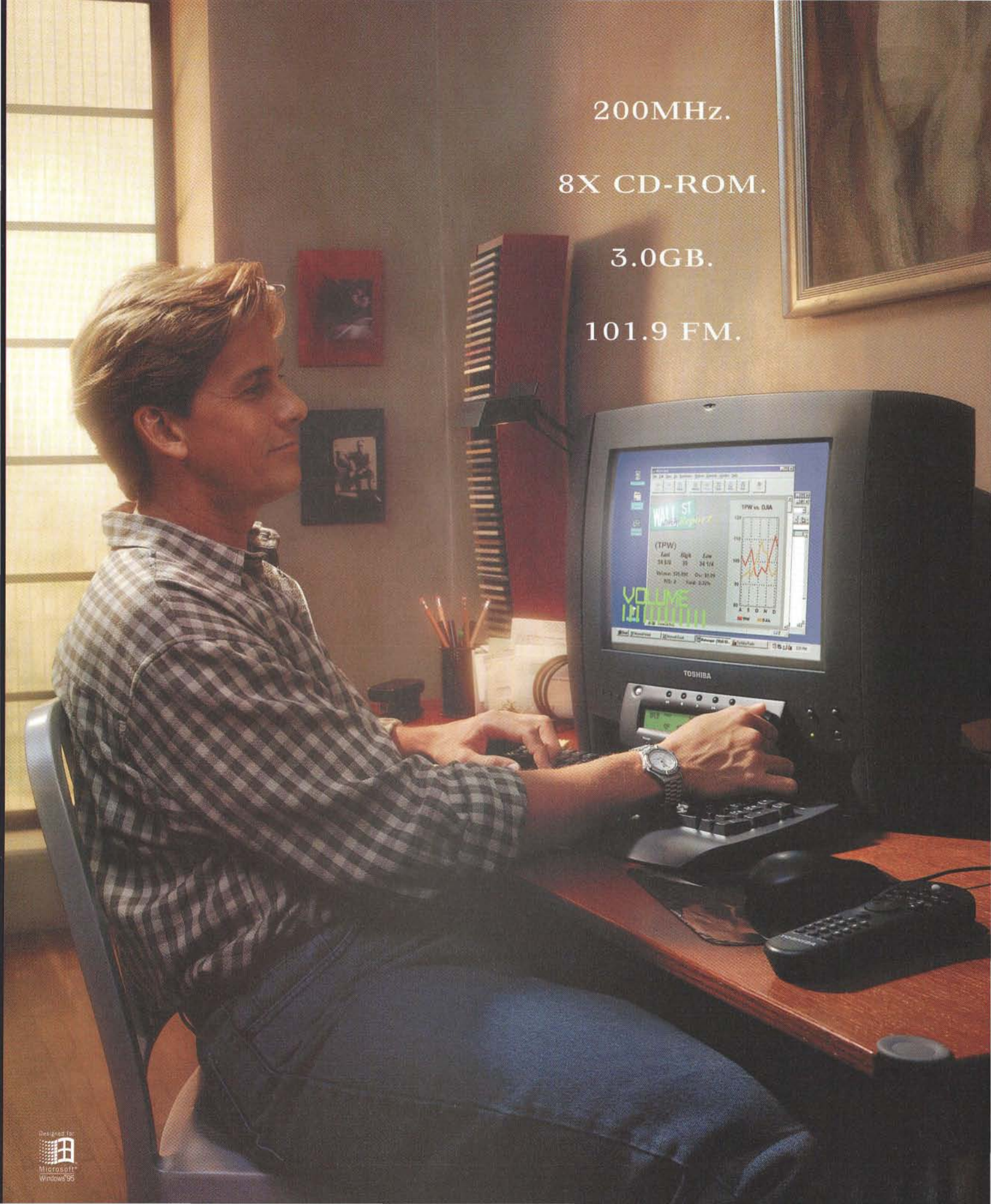
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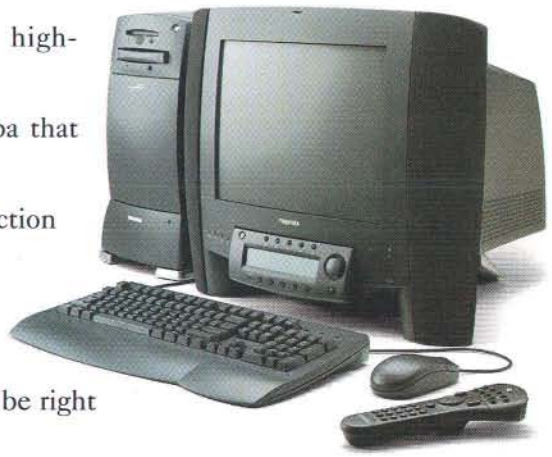

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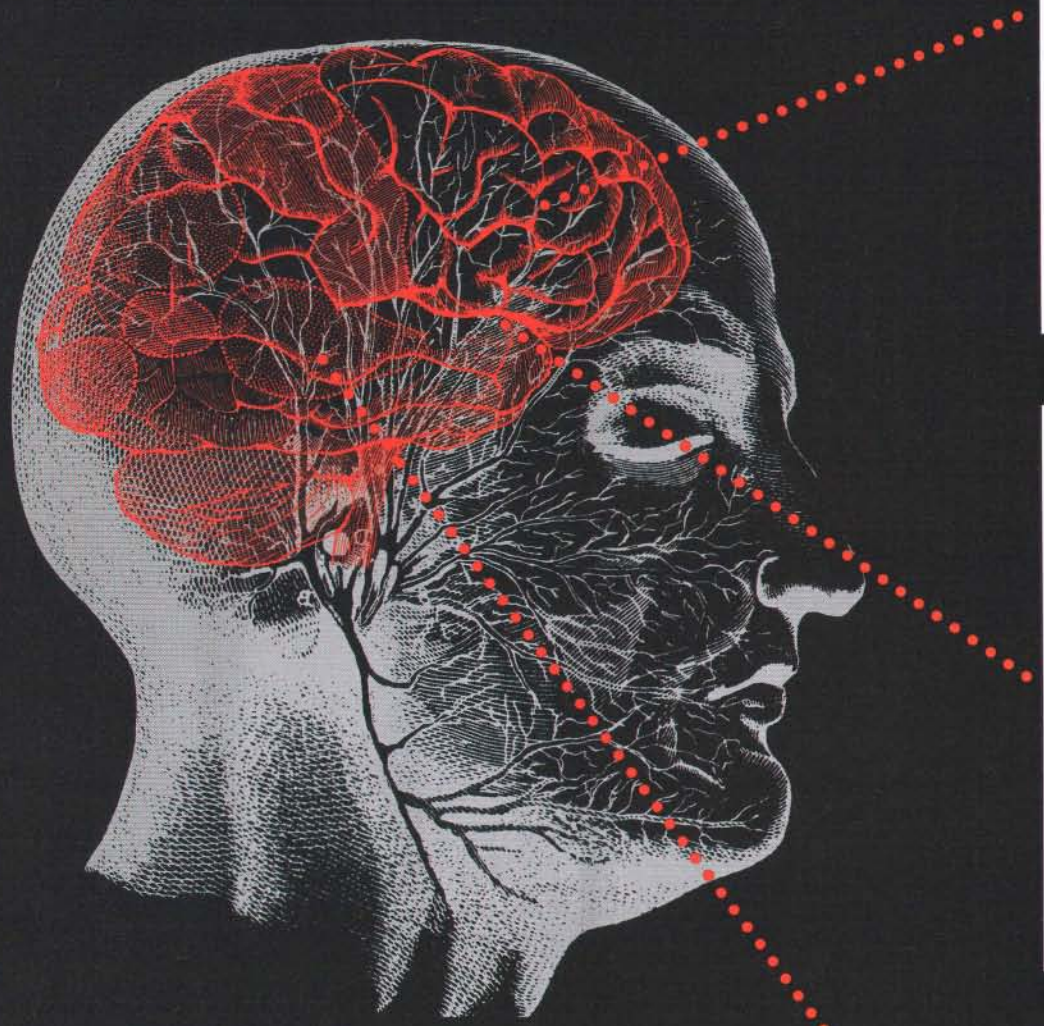

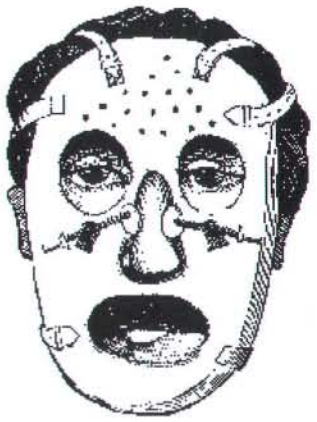

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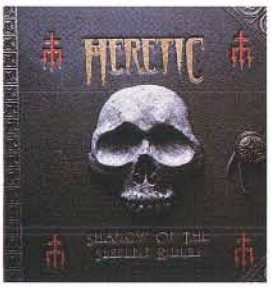

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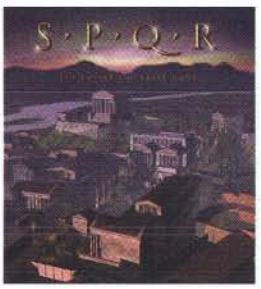

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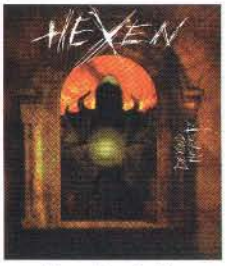
ANTISOCIAL PERSONALITY DISORDER:

A pattern of disregard for and violation of the rights of others. Elaborate weaponry is often involved.



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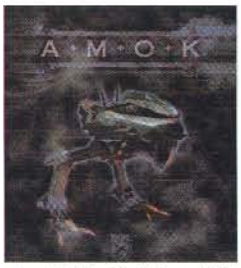

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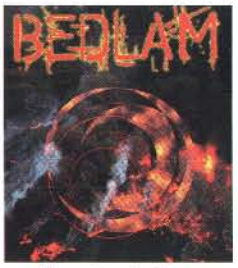

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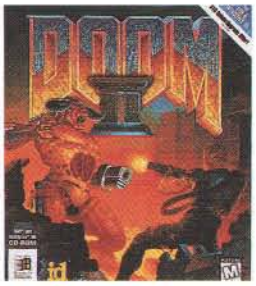

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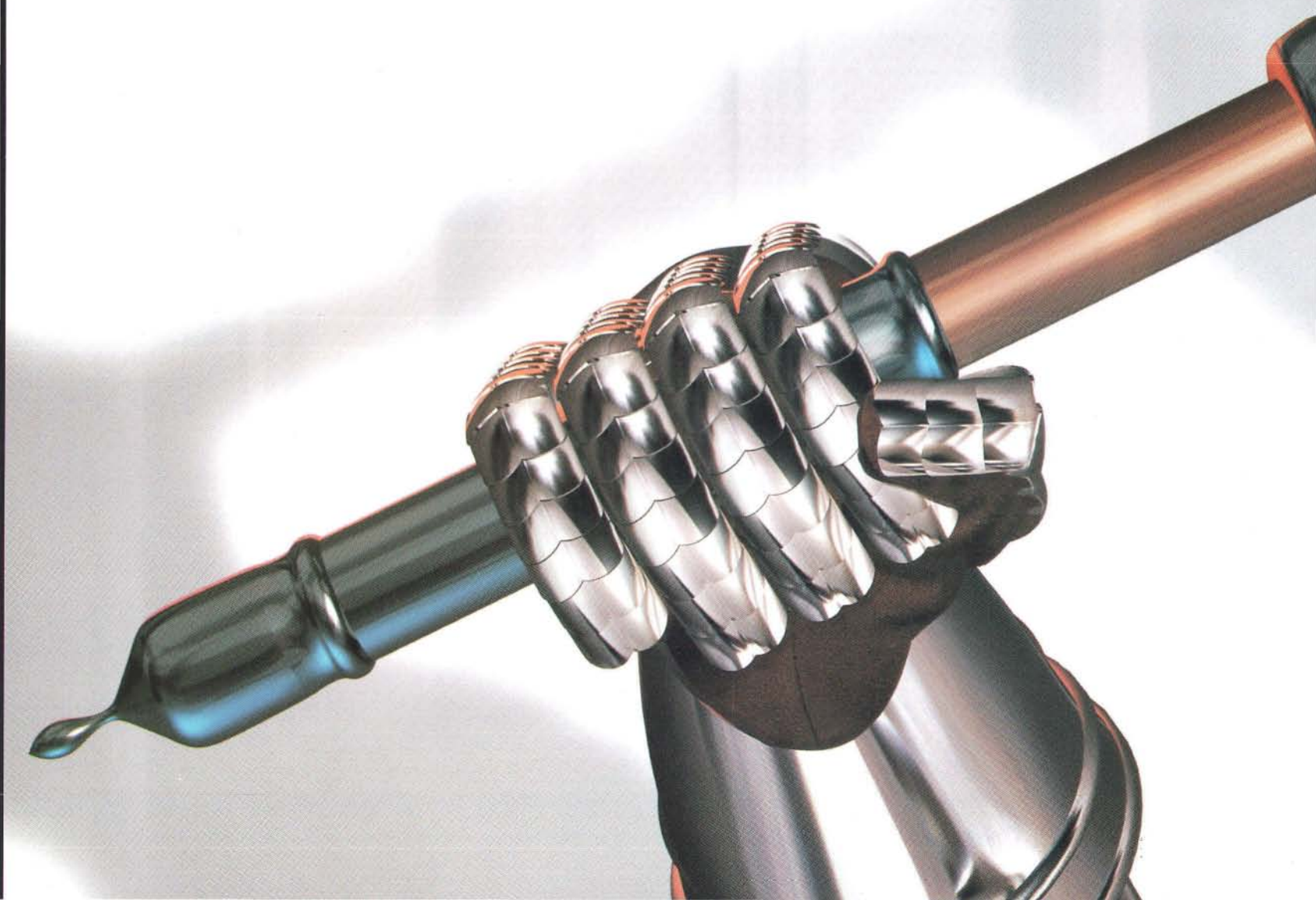

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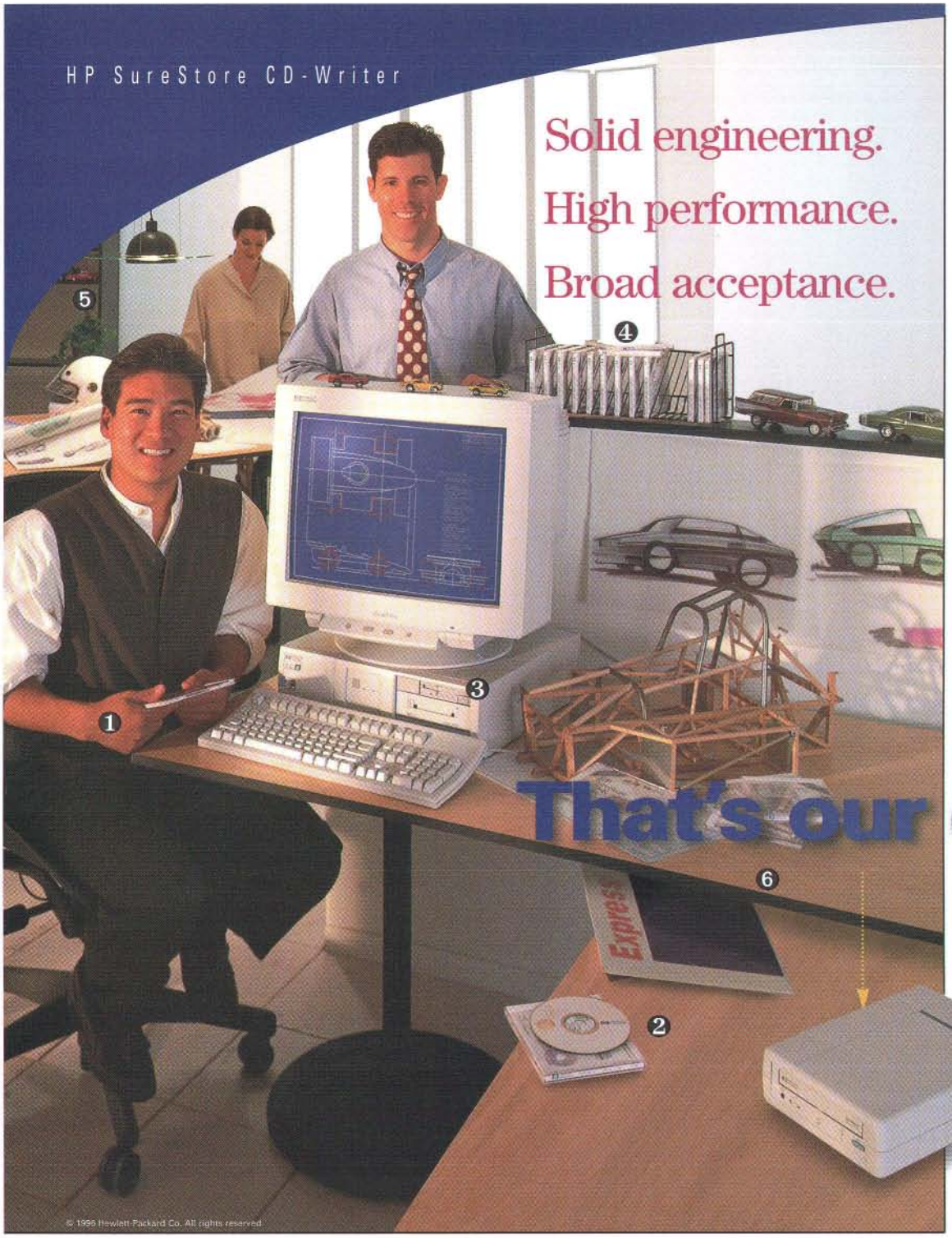

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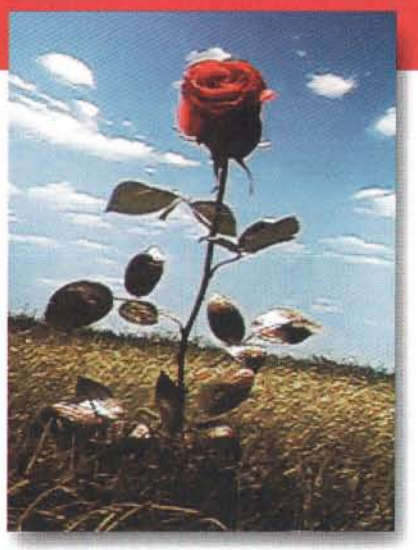

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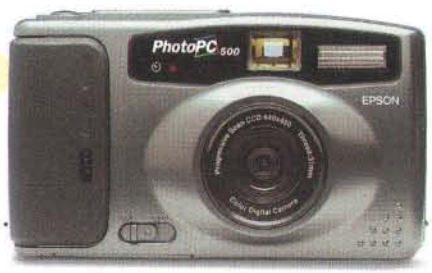

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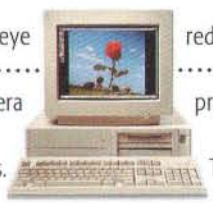

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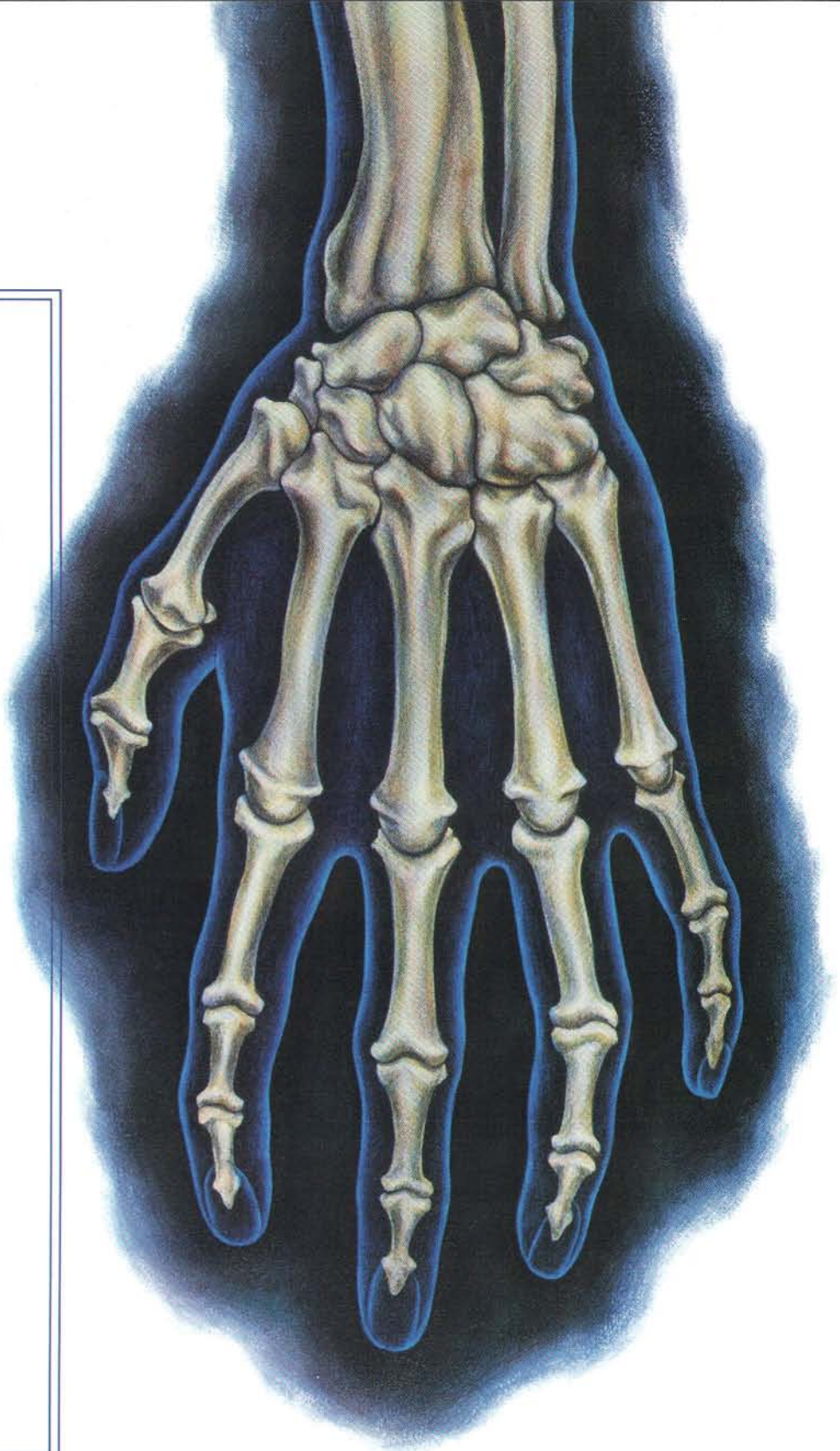

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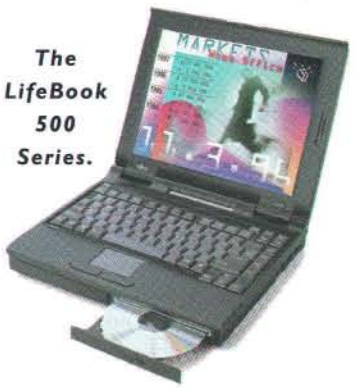

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Money Talks

Thanks for a superb interview with one of the truly great hucksters of our time ("The Future of Money," *Wired* 4.10, page 140). The reactionary infotopianism *Wired* promotes won't be complete until it embraces Walter Wriston's redefinition of democracy: fund managers manipulating the flow of stateless money to punish governments that try to stop people (*citizens*, in pre-information-age jargon) from getting completely shafted by money vultures like Wriston. And we should see this as a "plebiscite on policy"?

Forget what the word *plebiscite* means. Forget all the popular sovereignty garbage of old-time democratic governments that thought people ought to have an equal say in decisions that affect their lives. No, let's embrace Wriston's idea of "economic democracy" in which only capital fund managers get a vote. Such pure spirits will make those pesky governments accountable.

Oh, and let's be sure to forget the long, sordid history of Wriston's venerable Citibank. Even today, Citibank is embroiled in a federal investigation concerning money laundering for drug cartels. Wriston's democracy doublespeak is a real advance for the *Wired* view of the world.

William Pietz
pietzw@delphi.com

I enjoyed the interview with Walter Wriston. He certainly is nothing like the stuffy New York banker I imagined. I only hope that my mind will be half as alive as his when I'm 77.

Jack Lavelle
lavelle@primenet.com

Horton Heard Us

In response to the Net Surf titled "Horton Hears a Marketing Opportunity" (*Wired* 4.08, page 175), with its plea to make the site less promotional:

We've redone our Web site and made it more fun.
We've added a lot, but we're still not quite done.
We'll keep on improving and adding new looks.
(But oh, by the way, we still want to sell books.)
Please take a new look and we think you will say,
"The Cat in the Hat has some great games to play!"
So all you Seuss lovers can now give a cheer:
"We heard you in Seussville – loud and clear."

Randi Benton
President
Random House New Media
rbenton@randomhouse.com

Embedded Thoughts

I enjoyed "The Embedded Internet" (*Wired* 4.10, page 98) and wanted to offer a slightly different perspective.

The first weakness in the plan to use embedded systems to leverage the general populace onto the Net is the Net itself. Think of the choice: you can pick up a phone – knowing you'll get a dial tone – and mash 911, or you can press a button and get a "Failed to make modem connection" error message.

The second weakness is embedded systems, not to mention the hubris and blatant arrogance of embedded systems vendors. I have an automated engine room on my ship, fully certified for unattended operation of a 33,000-horsepower propulsion plant, and a 5-megawatt electrical plant. Sure, it works (sort of). And yeah, it's reliable (kind of). But it's nothing I'd spend my own money on. The smallest denomination of currency with which our automation vendor is familiar runs to six figures, and its shortest waiting period for a field change is half a solar cycle.

A final point on security. I'm *wired* to the Net. If a vandal breaks in and turns my microwave on and off for kicks, no big deal. But how far do I trust the Net? Is it fine to let the power company read my meter, or will it really be my meter it reads?

Again, I loved the piece. But the embedded system vendors I've dealt with are low characters with questionable morals. Princely sums for paltry technology! Put bluntly, I'd trust Microsoft before I'd trust an embedded systems vendor!

Chuck Becker
104262.731@compuserve.com

LETTER: JOSEPH A. STIRT

The true killer application of the embedded Internet will address a problem much less compelling than 911 service. In the future, all clocks will be online, polling every few seconds to determine the correct time. The hassles of resetting clocks for Daylight Savings Time, checking that the VCR has the correct time before programming a taping session, et cetera, will be eliminated and – *poof!* – another of life's minor but pesky inconveniences disappears.

Ray Ross
lalanovich@aol.com

Was it Yogi Berra who said "Prediction is hard, especially when it's about the future"? I remember a diorama from the World's Fair that offered a vision of life in the 1980s, when people would ride around inexpensively and luxuriously in dirigibles. This was before the Hindenburg disaster in 1937. Anyone who went to grade school in the '60s remembers the push for all-electric homes because in a decade or so nuclear power would be so cheap we'd pay just a flat monthly rate ...

As a technology writer, it stuns me that embedded technology has become so mainstream that it is covered in *Wired*. Two years ago the Embedded Systems Conference seemed more like a high school reunion than a major trade show.

1996 was the first year that embedded Internet or Java was even mentioned at the Embedded Systems Conference. But it's not a fad; it's here to stay.

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Maybe Java won't be the app that makes it into all the Net appliances, and maybe the Net will look completely different by the time it controls my home door locks, but the technology seems unavoidable.

My company (on the Web at *www.systronix.com/*) designs and sells embedded programming tools, though at the moment our hardware and software don't support network connectivity. Why?

Because most factories don't network their manufacturing systems. It's too expensive and difficult to set up and maintain. Plus, there's little to be gained by connecting a cheese cooker to a deep freezer. Different tools and machines (if they are computerized at all) don't speak the same language, so why connect them? I believe that will change, not overnight, of course, but pretty darn fast.

Who knows what the future holds? All I know is that it's sure to be interesting. I hope my new Internet-ready toaster is more crash-resistant than my PC.

Bruce Boyes
bboyes@systronix.com

Snow Job

I loved "Machine Translation" (*Wired* 4.10, page 84) but had to respond to the comment that "an Eskimo has lots of words for snow; I have one." We have many words for snow, especially those of us who live in ski country. These come to mind: powder, packing, mashed potatoes, sierra cement, champagne powder, crud, drifting, blizzard, whiteout, squeaky, consolidated ... the list goes on.

Mike McKenna
mikem@sdc.tiac.net

Copy Cops

Copyright hysteria has taken over. I recently went to the University of Waterloo photocopy shop to make a copy of the Rock and Roll Hall of Fame and Museum article (*Wired* 4.09, page 47) – which was, ironically, a satire on the silliness of some aspects of copyright and trademark law – but the operator turned me away. He refused to copy it on the grounds that (and I quote) "the postcard pictured cannot be determined to be a real postcard in existence or not."

Information may want to be free, but a million satraps are scared by the idea.

Jeffrey Shallit
shallit@graceland.uwaterloo.ca

No Such Thing as Freedom in Singapore

I just happened to be downloading Netscape 3.0 when I stumbled upon your Web page and found "Disneyland with the Death Penalty" (*Wired* 1.4, page 51).

I am a Singaporean and want to commend William Gibson's precise understanding of local terms, culture, and places. I cannot agree with him more about the direction this country is heading. The problem with today's political climate is that many Singaporeans don't realize that "Big Brother" is everywhere. And the local media just praises the government, printing things like "We are the world's best in this and in that." We *are* economically successful, but we are also politically immature and have been bred in an environment that teaches silence.

Thanks again for the article, and I thank the Internet for freedom of speech – it may not be around for long in Singapore.

Edwin Lam
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Singapore has never pretended to be a model for cultural exchange (Electric Word, *Wired* 4.11, page 42). Just as the US stands as the champion of freedom, Singapore is guided by its forefathers' dreams of peace and prosperity. I'm glad this nation is not as totalitarian as we are frequently viewed or I wouldn't be able to purchase your excellent magazine on the local newsstand.

Philip Tan Boon Yew
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What McLuhan Said

Kevin Kelly's interview with Derrick de Kerckhove ("What Would McLuhan Say?" *Wired* 4.10, page 148) reminds me that talking about Marshall McLuhan is like herding cats.

Twenty years ago, I studied under *Wired*'s patron saint and came to appreciate his interest in the future of religion. Updating and replacing this concern, the perplexed soul might well ask: In what ways does the Net refract the Clear White Light?

Emile Lefort
Luxembourg

Netheads vs. Bellheads vs. *Wired*

Networking protocol design is not about culture; it's about science. (See "Netheads vs. Bellheads," *Wired* 4.10, page 144.) I am not a Bellhead or a Nethead. I'm both. I ran a BBS for three years, a Fido-style mail network, a Net site, and I have worked for ISPs and telephone companies.

In the networking industry, ATM gets a lot of respect. A friend of mine, who is so deeply involved in protocol design that his bathroom walls are lined with header information, called ATM "the perfect protocol."

Steve G. Steinberg is right that the variable-length headers are much more efficient and adaptable. However, a cursory glance at any ATM book will explain the reasoning behind the fixed-length cells. ATM is not designed for audio, video, or data traffic. It is designed to handle *all* of them. Real-time multimedia and telnet have very different requirements. Data that should be circuit-switched should be circuit-switched; data that should be packet-switched should be packet-switched. ATM allows for this.

If we are going to have an information infrastructure that handles audio, video, and text data – real-time or not, datagram or stream, with all the traffic decentralized and many-to-many – we need a protocol that can handle it all. POTS can't. ISDN can't. IP can't. ATM can – and will significantly reduce the costs of high-speed networking. *Wired* should stick to politics and leave hacking to the IEEE.

Tom Cross
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Having played significant roles introducing and implementing advanced network technology at Sprint between 1991 and 1995, we couldn't resist responding to "Netheads vs. Bellheads."

The Netheads are wrong. Bandwidth isn't cheap. (Note: This belief is rooted in the fact that the federal government subsidized much of the global Internet through 1994.)

We have worked with several generations of SprintLink engineers. They are all terrific at what they do and are as critical to Sprint's Internet operation as you suggest. But have those engineers ever had to make a business case that justifies additional network capital/network bandwidth? In preparing that case, they may find that the cost of that "cheap bandwidth" generates only minimal (if any) profit margin given the Internet's fixed, flat monthly price approach to service. The Bellheads have been justifying additional bandwidth for decades, which is why they rarely say "bandwidth is cheap."

The Netheads have yet to face "real" performance requirements. Internet service providers will not provide network performance guarantees (or even objectives). If users experience delays or connectivity problems, they try a ping or trace route. If they feel the results are unacceptable, they report the problem to their service provides. In turn, their service provider first explains that pings and trace routes are not reliable ways to measure performance because they are "low-priority packets" and the network is "very dynamic." And if that doesn't work, it explains that the performance problem is not with the network but with one of the many networks that the user must connect through. And if that doesn't work, it hides behind the fact that the Internet technology is very new and will sometimes break under the stress.

To the contrary, the Bellheads have been there ... starting with the telephone Grade of Service that is published in tariffs. Currently, ATM users are *contracting* for end-to-end performance guarantees that include maximum network delay thresholds and high network reliability requirements. If the service does not meet the requirements, the service provider *refunds* some portion of the price. We have not heard of ISPs backing up their service with money.

No matter how you measure it, the Internet is much smaller than the public carrier networks. And scaling up will create extraordinary stress on the

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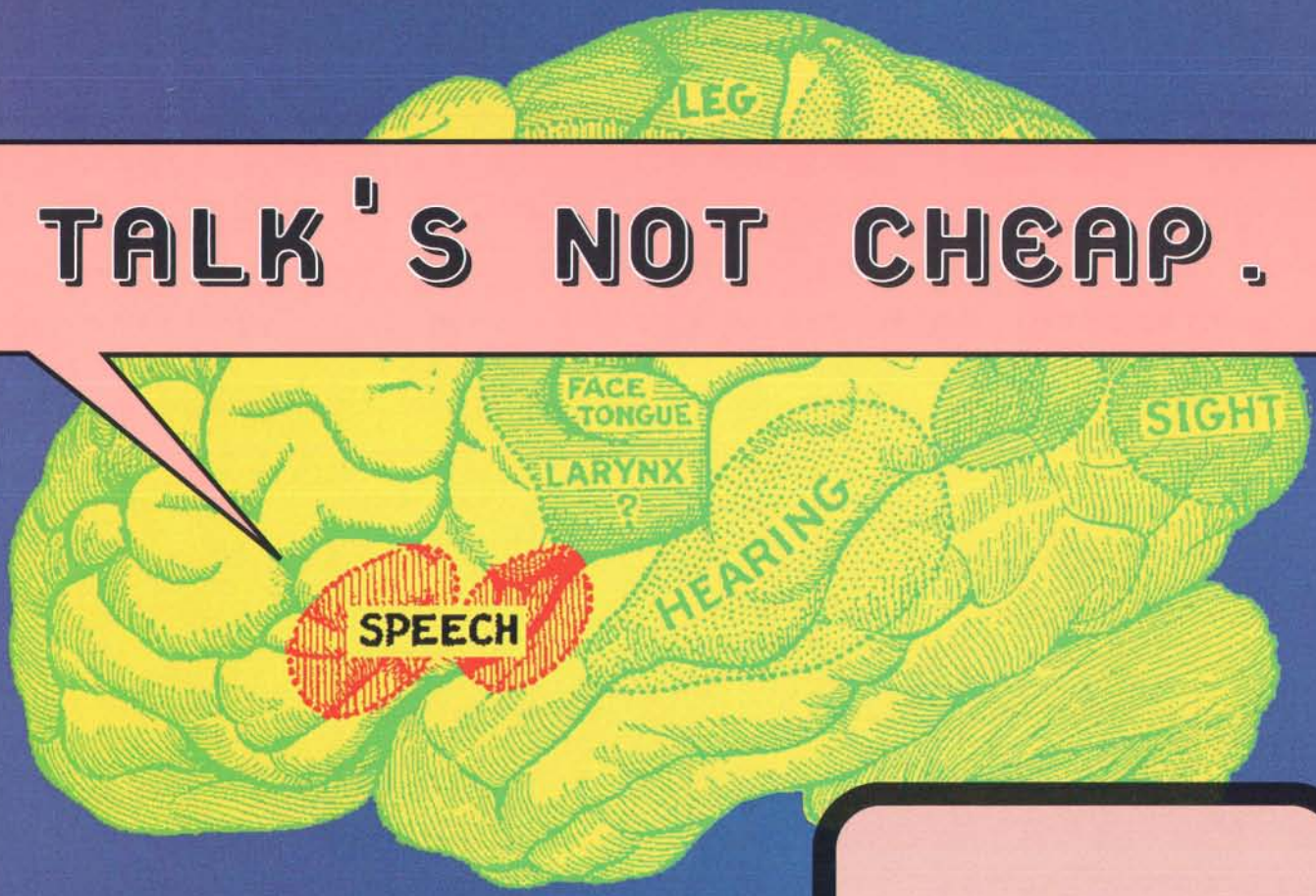

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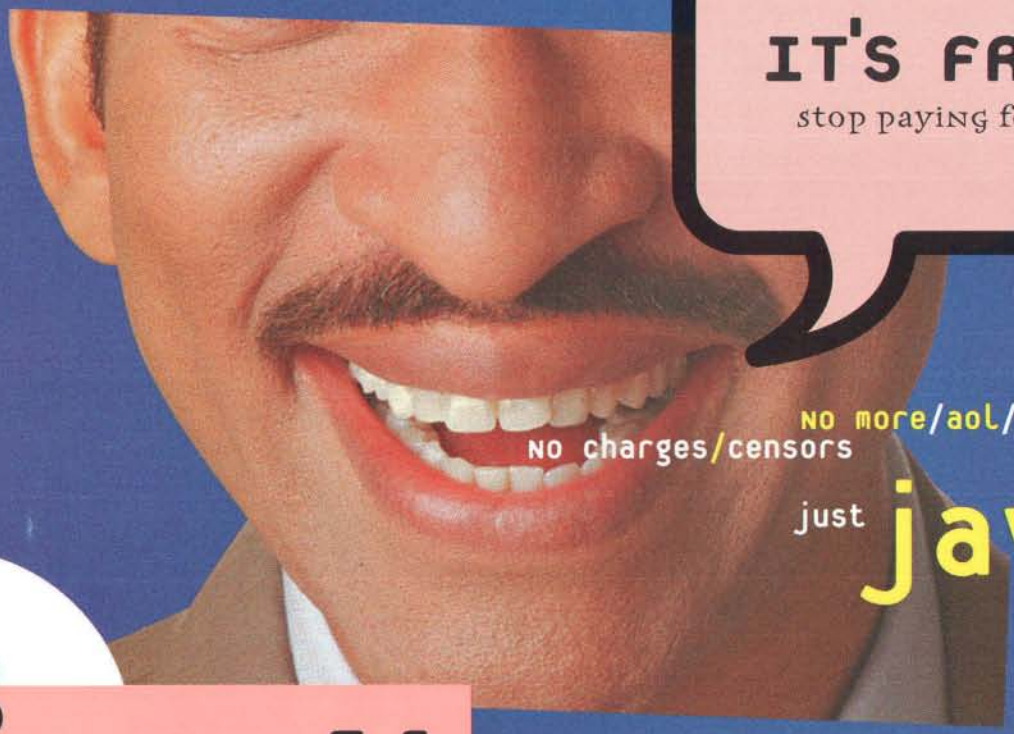

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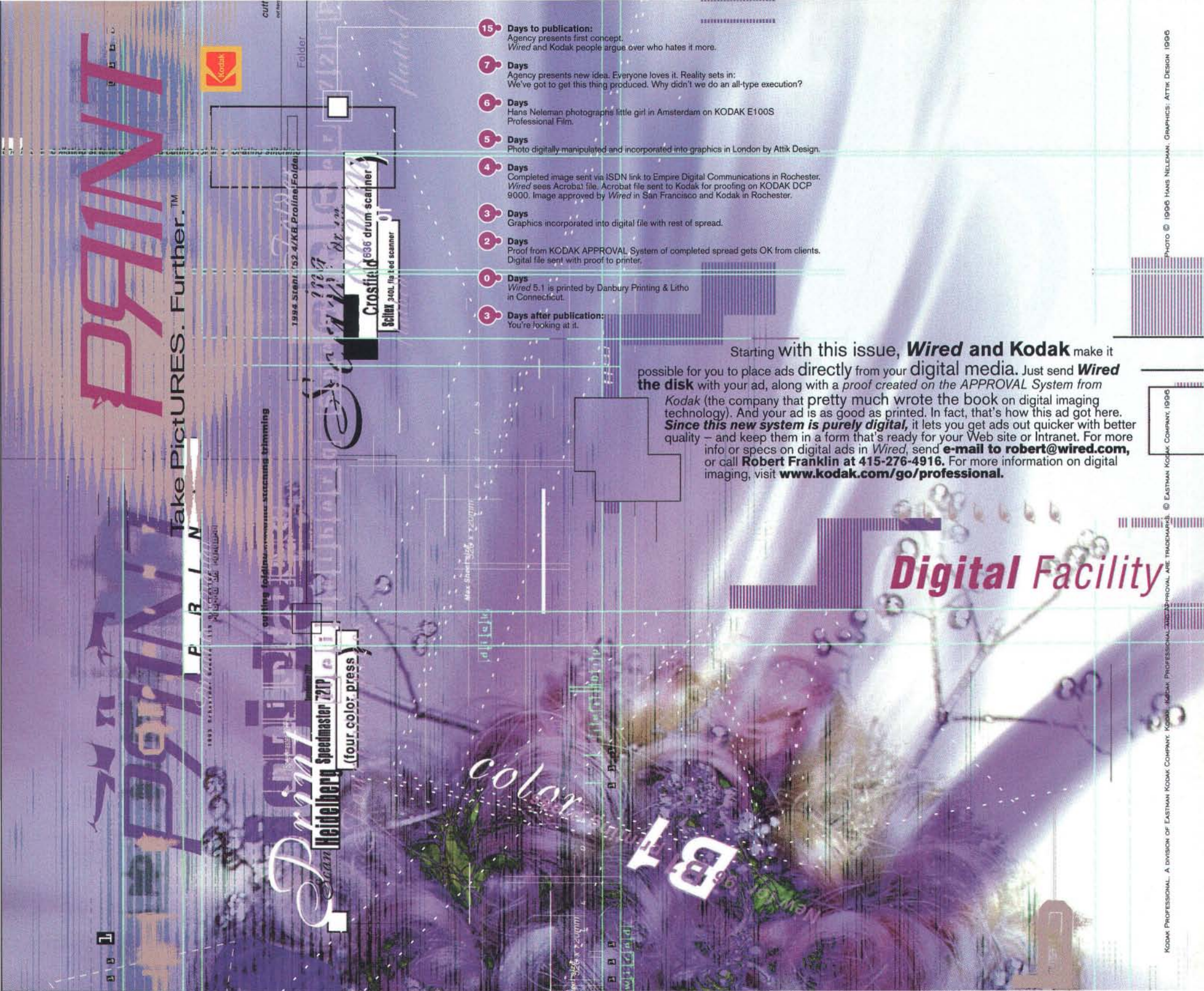

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current Internet. The Bellheads have successfully addressed this issue, creating a network of enormous complexity that presents a simple common interface to billions of users worldwide.

Internet technology supports a terrific communication system and has contributed more to computer interoperability and electronic information exchange than any other computer technology. As a stimulus to electronic commerce and intercompany communications, the Internet has no peer technology. But the jury is still out on the Internet technology's ability to meet future bandwidth and network performance requirements.

The jury is also out on ATM. Will users have to sacrifice some of the interoperability that the Internet provides in return for performance guarantees? And ultimately, how will the costs of each service compare?

The debate between the Netheads and the Bellheads is healthy and important for the advancement of network technology. But it's time to get beyond the emotional and religious fighting and on to a reality based on facts, figures, performance, and deployment.

Tim Clifford and Bob Doyle
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Of Mice and Pac-Men

"Spawn of Atari" was beautifully written and very accurate (*Wired* 4.10, page 166). I worked for Atari Corp. just after its heyday – from 1987 to 1992 under the Tramiels. I was 21 and had left college because I dreamed of working for Atari, not realizing at the time how much the company had already changed. The Atari 400 and 800 shaped my future, and I knew instantly what it was I wanted to do with my life.

Thanks for summing up the history of Fuji U., as my coworkers and friends often referred to Atari. It's an important part of Silicon Valley's history.

Jerome Strach III
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Computer Firsts

Colossus was a very important computer for the Allies during World War II ("Resurrecting Colossus," *Wired* 4.10, page 78). And Howard Aiken's Mark I, finished in 1944, was a major achievement. But neither was the "first" computer.

Konrad Zuse (1910-1995) created the first functioning, freely programmable, and fully automatic computer. The Z1, a test model, was completed in 1938 in Germany. The Z2, a functioning electromechanical computer, was completed in 1940. The Z3, the first freely programmable computer using binary arithmetic, was operational in 1941. The Nazi régime never recognized the importance of Zuse's invention. Zuse had applied to the German Ordinance Department regarding an encoding and decoding machine, but he was rebuffed as it was thought that Enigma was absolutely undecipherable.

Destroyed in air raids in 1943 and 1944, the Z3 was reconstructed in 1960 for the Deutsches Museum in Munich. A rebuilt model of the Z1 is in the Berlin Museum für Verkehr und Technik. For more information on Konrad Zuse, read his autobiography, *The Computer – My Life*.

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Hacking Language

Wired seems to be laboring under the misconception that the people who break into computers are hackers and that what they are doing is hacking. Please remember that it is hackers, not these lowlifes, who made it possible for there to be an Internet for you to publish articles about. Take the time to refer to crackers as crackers. If you can't be bothered to correct this mistake, you will be showing, once more, that Corporate America is incapable of respecting the people who make everything possible.

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Seeing Red

As a scientist and fan of your technology-worshipping magazine, I cringe whenever I read an egregious scientific error in *Wired*. Although I found the "Tired/Wired 100" (*Wired* 4.09, page 148) to be thoroughly enjoyable, the very first entry refers to Earth's smaller neighbor Mars as "the red giant." Mars is indeed the Red Planet, but it is no giant.

On another astronomical note, the recent interest in EUV lithography has an analog in the world of astronomical research. The EUV wavelength region recently became the final region of the electromagnetic spectrum to be subjected to astronomical observation. This was made possible by one of NASA's smaller, cheaper satellites, the Extreme Ultraviolet Explorer (EUVE). The UC Berkeley scientists behind the EUVE are pioneering new low-cost techniques for spacecraft support that may be the wave of the future.

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Lost and Found

It is the *real* story that gets lost in "Lost in Translation" (*Wired* 4.09, page 130). The Web drives the explosive use of digital text across national and cultural borders. Digital text requires character encodings. Out of the babel of incompatible and single-language character codes of the '60s, '70s, and '80s now rises The Unicode Standard as a comprehensive attempt to put both major and minor languages and scripts on equal footing.

Rather than truncating or mutilating people's heritage "for the sake of computers' convenience," as the article charges, Unicode reflects a strong commitment to eventually and fully support all languages.

In a tale reminiscent of C. P. Snow's classic *Two Cultures and the Scientific Revolution*, the disconnect happens when technical realities intrude. Jose Manuel Tesoro charges that Unicode's support of Chinese is incomplete and arbitrarily limited to 20,000 of 75,000 Chinese characters, and that it is now "too late for the remaining 40,000 or so rejected Chinese characters." In its first version, Unicode supported only 65,355 characters; version 2.0 will recognize 1,114,112. This is not a simple, straightforward process – it takes many years to create a usable character set from scholarly listings, old dictionaries, and other sources. But the process of adding characters to Unicode is ongoing.

It always makes good copy to blame the evil technoids for trampling human culture underfoot, but the *real* story here is the developers, managers, and engineers who are dedicated and committed to breaking out of the confines of '70s and '80s ASCII-centric technology. Unicode is a real and practical step in that direction, and it retains the potential to grow along with the needs of its users.

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RoboFarm

What's the agricultural revolution all about if not getting smarter? ("Weed-Whacking on Smart Farms," *Wired* 4.10, page 160.)

It will be a long time before a robot outthinks an illiterate, poorly trained lackwit farmhand when it comes to differentiating tomato seedlings from weeds. But give him a VR helmet and gloves that let him control a simple digging robot in the field from the comfort of an air-conditioned factory, and you've got cheaper produce and better working conditions for the laborer.

John Wiley
jtwiley@ingr.com

Undo

▪ Grim News: The photo of Nicholas Grimshaw's Western Morning News building ("Tightrope," *Wired* 4.11, page 188) should have been credited to Jo Reid and John Peck.

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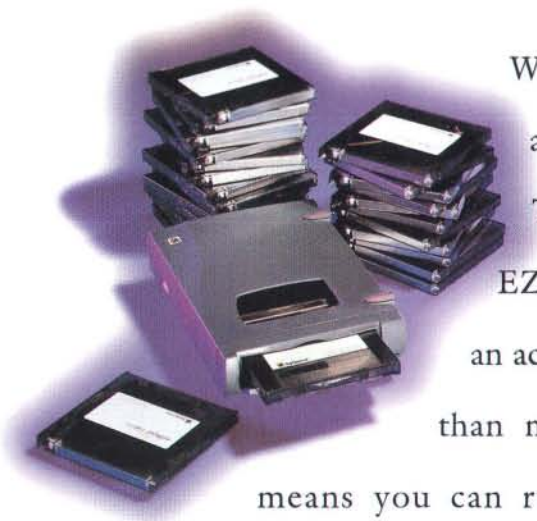

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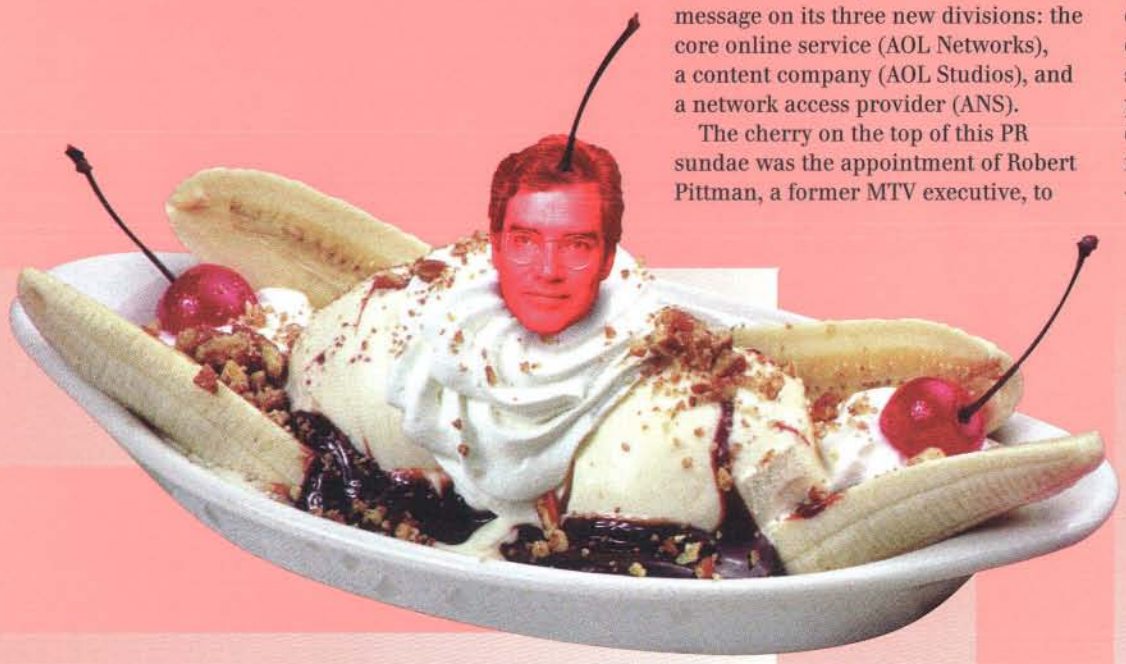


When America Online announced its corporate "repositioning" strategy in late October, the blizzard of publicity nearly obscured the bottom line: a US$300 million loss that wiped out every profit the company ever recorded. Instead, AOL focused the message on its three new divisions: the core online service (AOL Networks), a content company (AOL Studios), and a network access provider (ANS).

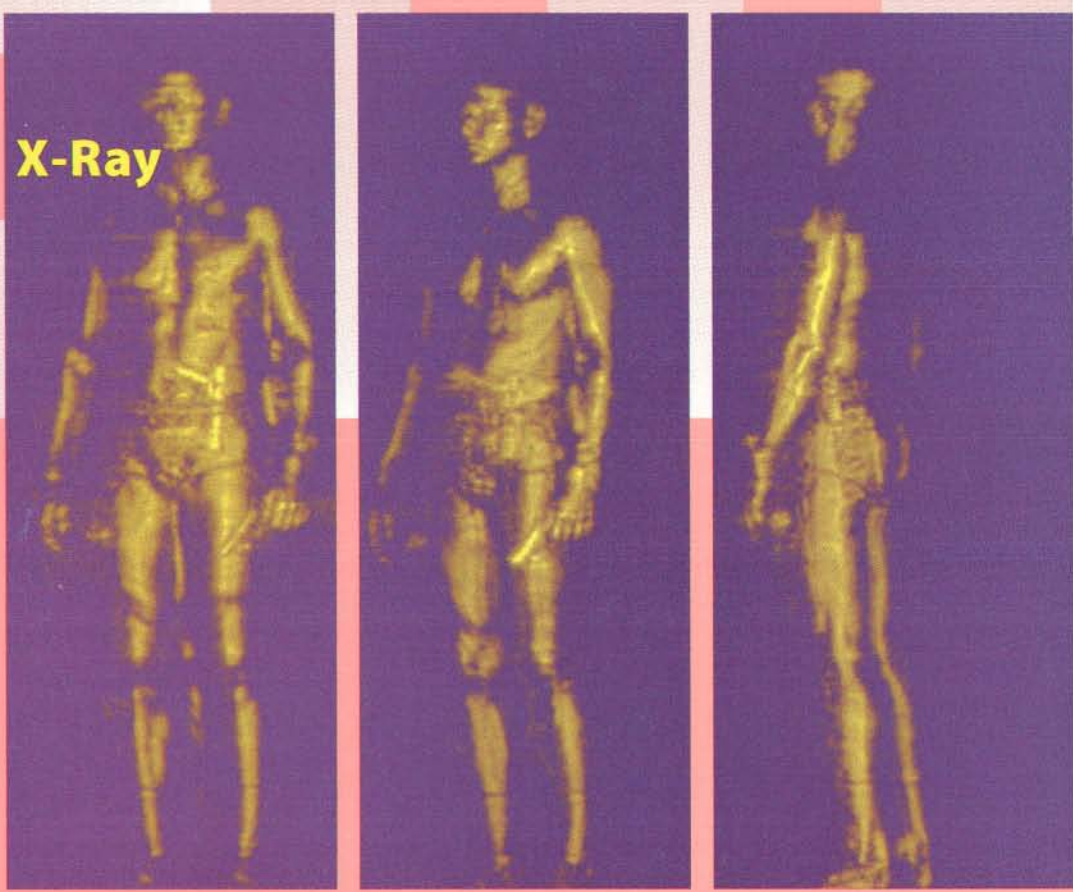
The cherry on the top of this PR sundae was the appointment of Robert Pittman, a former MTV executive, to run AOL Networks, which further propagated AOL's long-running claim that it's the next MTV.

We're not buying it. But we do find another rumor entirely believable: AOL's reorganization is merely a prelude to an AT&T-style breakup, with the divisions to be sold off to different buyers. The first to go, Wall Street-types suggest, could be profitless ANS and its pool of modems and fiber. Like a broken-down old car, AOL may be worth more in parts than whole.

– *Ned Brainard*

E L E C T R I C W O R D

X-Rated X-Ray

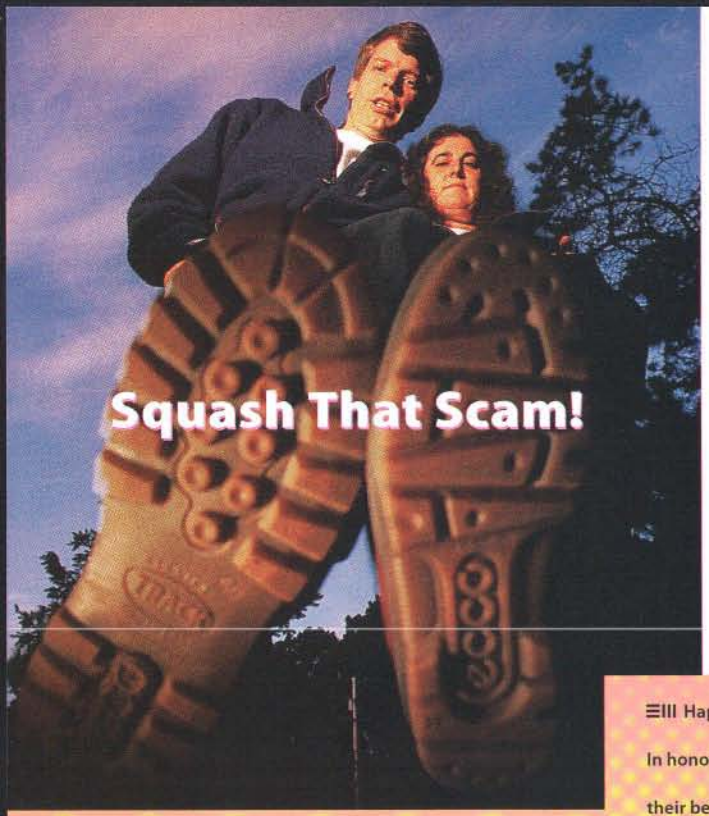


Some anxious Americans may willingly shed their privacy for the sake of safety. But the latest airport security technology should cause even the least discreet traveler to draw the line.

Pacific Northwest National Laboratory's holographic imaging radar bounces millimeter waves off the body. These emissions pass completely through clothing but not metal, plastic, or skin. The result: an embarrassingly vivid image of your birthday suit. The FAA plans to use the technology to scan passengers for concealed weapons, with testing in a US airport to begin early this year.

The system is already raising eyebrows. "There might be special situations where such a device could be useful," writes Lauren Weinstein of the Web-based Privacy Forum *(www.vortex.com/)*. "But broadscale deployment of such systems in airports seems unlikely to be acceptable to most of the public."

– Michael Behar



Squash That Scam!

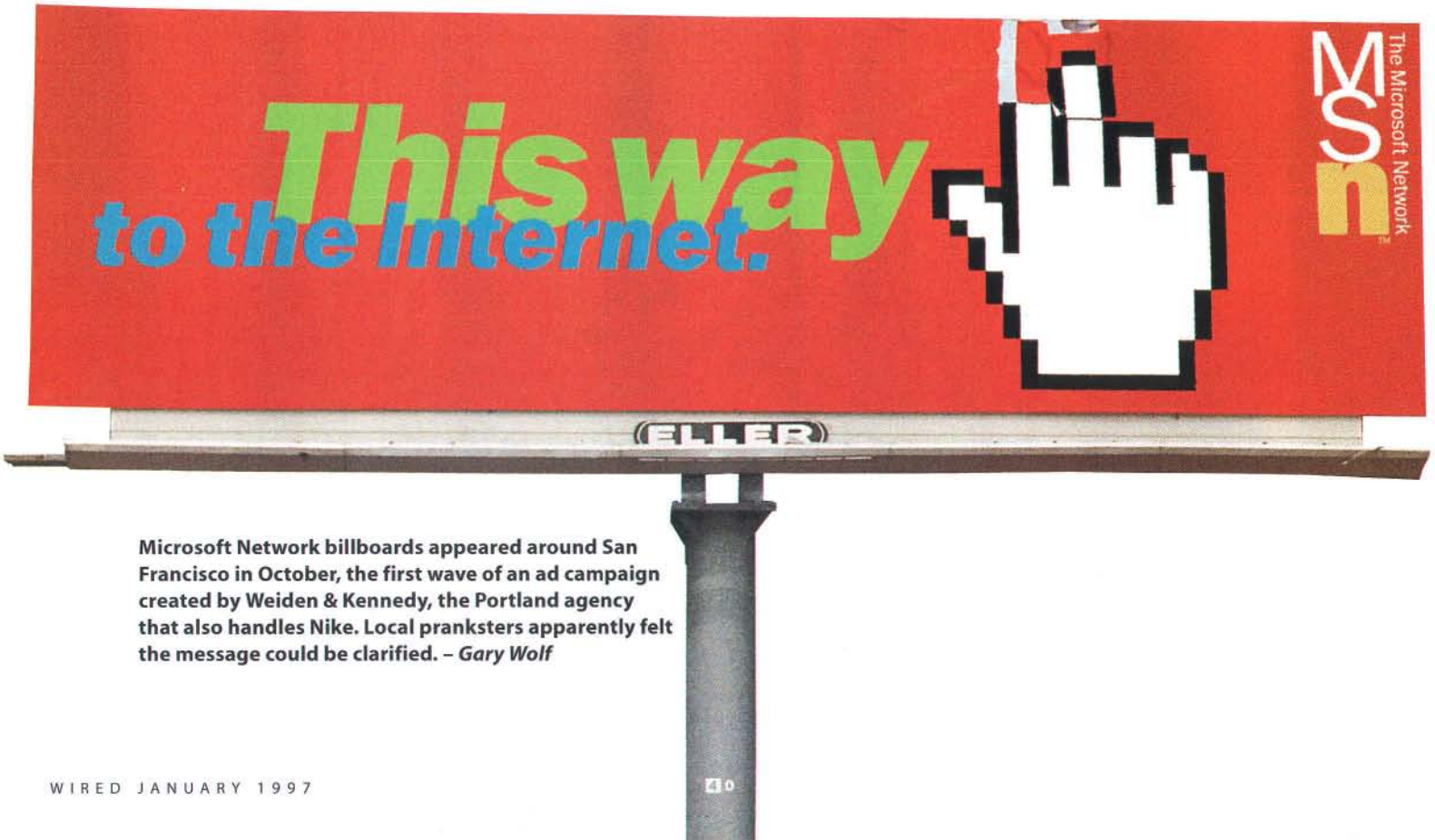
Internet marketing consultant Audri Lanford started *Internet ScamBusters* last year with her partner and husband, Jim, "after we became furious coming across scam after scam" on the Net. The Web zine *(www.scambusters.com/)* is an action alert network that digs up dirt on Net and telecommunications fraud, ranging from "services" that charge astronomical prices for domain name registration to con artists who partner with Caribbean-based companies to rake in crooked pay-per-call charges.

The Lanfords, who make their living offering Net marketing advice to businesses that are migrating to the Net, publish an issue of *ScamBusters* whenever they learn of a new rip-off, usually from a reader's tip-off.

The Net is a fertile ground for con games, Audri says, because "it's easy to be anonymous, it's cheap to do huge distribution, and it's easier to be dishonest when you are not dealing with people directly." But, she adds, the vast majority of Web sites are run by honest people – so there's "no reason to panic" about being scammed.
– *Mark Frauenfelder*

☰III Happy Fuckin' New Year: Remember when we did "The Wired Scared Shitlist" a couple of years back (*Wired* 3.01)? In honor of our boundless optimism, we decided not to revive it this year, but governments everywhere are doing their best to force our hand. Here's some of the crap they're trying to pull around the world. In the US, a new level of encryption inanity has surfaced, and this time global behemoths Philips and Sony have been manacled. Seems the two companies' Web-television offerings – which include secure transaction systems – are classified as munitions by Uncle Sam. The new boxes cannot be shipped internationally. Memo to anyone depending on overseas revenues to float a risky and innovative new product: Don't even think about it. In Japan, the Ministry of Home Affairs banned all political Web sites the week before elections. Why, one might ask? The law "does not say you can use the Internet" for politics, a ministry doublespokesman told Reuters, "therefore you cannot ►

Sign of the Times



Microsoft Network billboards appeared around San Francisco in October, the first wave of an ad campaign created by Weiden & Kennedy, the Portland agency that also handles Nike. Local pranksters apparently felt the message could be clarified. – *Gary Wolf*

PHOTO ABOVE LEFT: WILLIAM MERCER McLEOD; PHOTO BELOW: J. BUTLER; PHOTO OPPOSITE: RAFAEL FUCHS

Armed with a satellite dish and a VCR, Jed Rosenzweig spent nine months capturing unscrambled network feeds, including off-air footage of news anchor Tom Brokaw questioning colleague Dan Rather's

Who's Got the Power?

sources. Rosenzweig (below), an aspiring documentarian, planned to air these gems on *Wild Feed TV*, his public-access show in Manhattan.

But in September, NBC, angered by the Brokaw footage, sent two cease-and-desist letters claiming the show had violated copyright law. Rosenzweig's attorney, Robert Perry, disagrees: "This is not copyright infringement." The law's fair use provision, he argues, allows for media to be repurposed for criticism, education, and commentary.

With *Wild Feed* temporarily off the air, Rosenzweig has turned to the Web *(www.wildfeedtv.net/)*: "It'll be a place where I can get my point of view out." – *Julie Sullivan*

Of all the companies that make speakerphone modems, only Global Village considers how somebody would actually use one. So we added a simple button to answer calls when your computer is off or (#@*!!) down. No other speakerphone modem lets you do this. Other common sense additions include Global Village's Focal Point™, the only software that integrates fax,

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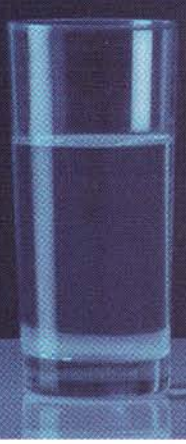

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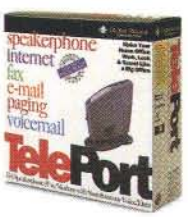

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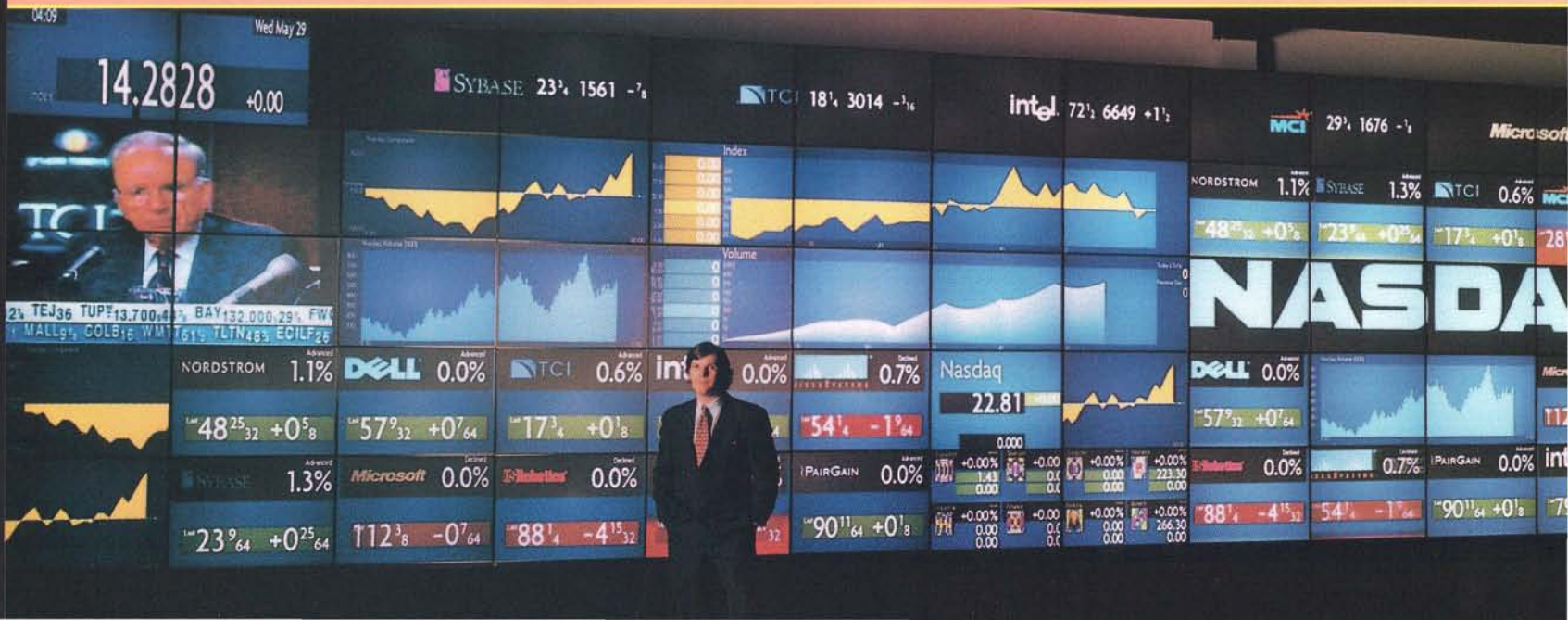
Space, the Final Resting Place

During a 1992 flight of the space shuttle, *Star Trek* creator Gene Roddenberry became the first and only person whose remains have orbited Earth. Now, anyone who's ever wanted to be an astronaut can make it into low-Earth flight, at least after she or he dies: for a fee of US$4,800, Houston-based Celestis Inc. *(www.celestis.com/)* offers burials in the Great Beyond. On Celestis' first mission this month, a few symbolic grams of the ashes of Roddenberry, space colony designer Gerard O'Neill, Timothy Leary, and a handful of other out-there pioneers are scheduled to hitch a ride into space on a Pegasus rocket. The ashes should remain in orbit for about two years, until they burn up in a flash of light when the booster reenters Earth's atmosphere.
– *Dave Cravotta*

IMAGE ABOVE: NICOLE CHIALA; PHOTO ABOVE OPPOSITE: AP PHOTO/MARTY LEDERHANDLER

► use it." In Iran, the Ministry of Posts, Telegraphs, and Telephones is centralizing all Net access to maintain a "certain level of decency." Uh huh. And last but not least, the Israeli-Palestinian conflict has reached ISPs: the Palestinian Information Ministry recently accused Israeli authorities of blocking Internet service because Palestinians were using the medium to "inform the world of Israel's illegal activities." Reminds us of this year's spoof G. M. Harding Institute for Civic Responsibility essay contest. The topic was "Good Government." The winning entry, in its entirety: "Good government. Good government. Sit. Stay." ☰III Webevision: Relentless pollsters Yankolovich Partners recently called 600 unwired folks and asked them whether they would prefer to get Net access via their television or their personal computer. Not surprisingly, the majority of those surveyed said they'd be pleased as punch to get the Net on TV. More likely than not, they'd also like what comes over the Net to be as professionally produced as TV, and as easy to digest. ►



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Team players	Free electrons
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Ferrets	Hedgehogs
Rules Girls	Modem grrrls
Ralph Nader	Darth Vader
Spam Kings	Bankrupt Spam Kings

Is Walter Watching?

Wall Street pundits aren't the only ones uneasy about the selection of John R. Walter as AT&T's new president and heir apparent to Robert Allen's throne. Turns out Walter, former CEO of the R. R. Donnelley printing company, gives privacy activists the willies as well.

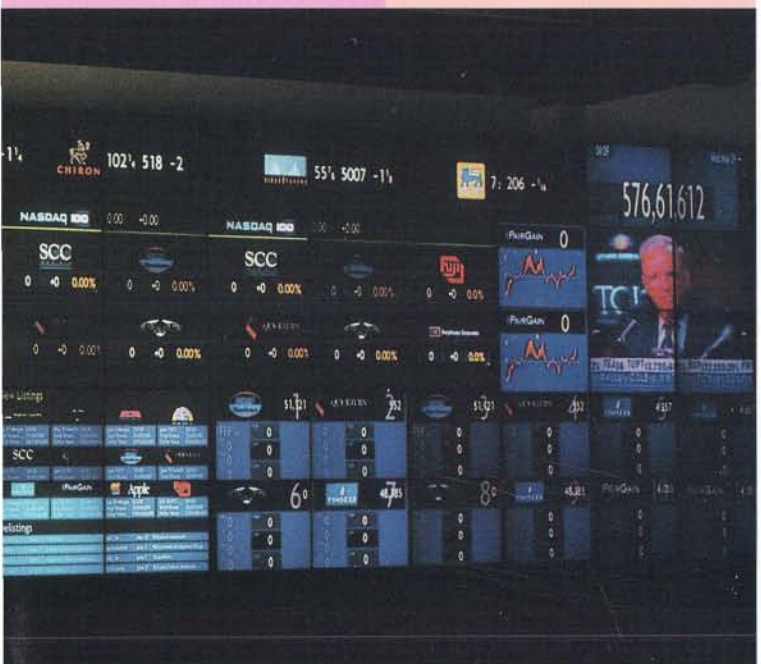
During Walter's tenure, Donnelley's Metromail division, which specializes in the collection and sale of consumer information, was rocked by privacy scandals. In 1994, there were charges that Metromail had improperly used lists of California registered voters for commercial purposes. Then came the revelation that an Ohio grandmother had received a threatening letter from a convicted rapist who obtained her address while entering data from Metromail surveys at a Texas prison.

In June, Metromail sold information on 5,500 children to a Los Angeles reporter who used the name Richard Allen Davis – the convicted killer of Polly Klaas.

"There was a pattern of blatant disregard for privacy while Mr. Walter was at Donnelley," says *Privacy Times* publisher Evan Hendricks. "When people brought up their concerns, he stonewalled like a bureaucrat. Now he's moved to AT&T, where he'll be sitting on an even more valuable gold mine of information. I just hope he doesn't abuse it."

– *Todd Lappin*

► The company also found that for those still offline, the greatest obstacle to getting wired was the cost of a PC. And this is the kind of research that funds companies like WebTV Networks. ☰III More Studies: Regardless of whether it's on a TV or a PC, net.growth continues to be bolstered by a flood of research. Household connectivity has doubled in the past year to 15.1 million homes in the US, according to Find/SVP. And Inteco Corp. estimates that number will nearly double again, with 13.5 million new households coming online in the next 12 months. ☰III Cowpuckey: We have one reply to Pacific Bell's recent whining that Internet use is clogging up its "normal" phone lines and taxing its profitability: Bullshit. ☰III The Ultimate Urban Myth: We've all seen them – the outlandish memes that almost makes us believe, until some net.savvier buddy pulls the wool from our eyes. Here's the ►



Wall Mart

The flashiest piece of hardware on Wall Street isn't a gaudy Rolex or a slick satellite phone. It's Market Site, a sprawling 100-screen video wall that may give Nasdaq the visceral punch the computerized virtual marketplace has always lacked. The 55-by-16-foot visual blitzkrieg stretches across the ninth floor of Nasdaq's headquarters in New York's financial district, with dozens of sources pumping in everything from bid/price quotes on the market's 5,000 traded stocks to video feeds from CNN, press releases, and Reuters news reports. Paul Noble, CEO of Market Site developer Imtech Corp., says the rapidly changing electronic quilt lets the scions of high finance "sense the market conditions. We'll let them feel the trends." – *James Daly*

The Thai Cost of Business

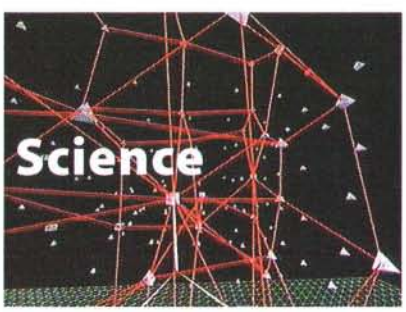
While a recent *Internet World* study reports that more than 186 countries are now reachable via email, reasonably priced Net access is still a foreign concept to most folks around the world.

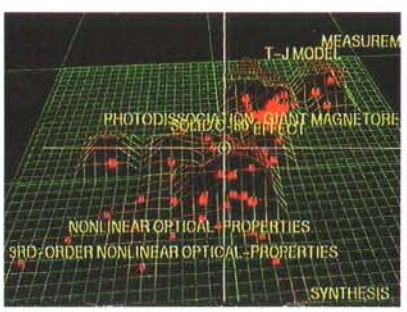
The *Bangkok Post* – one of Thailand's biggest English-language newspapers – found this out the hard way. For a pair of dialup lines and a few megs of server space, its monthly bill came to B25,000 (US$990). The problem, according to site director Theo den Brinker, is that the government owns a third of each ISP and is reluctant to open the market to private enterprise.

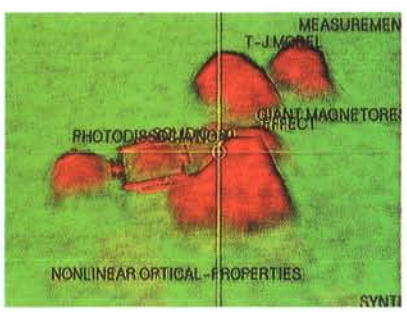
In October, *www.bangkokpost.net* started being served from the US, and the paper now pays just $30 per month. While this type of workaround may help other Net publishers in Thailand and elsewhere, two other groups continue to suffer: the burgeoning Internet businesses that want to build local infrastructure and the users who want to see what this World Wide Web is all about. – *Bob Parks*

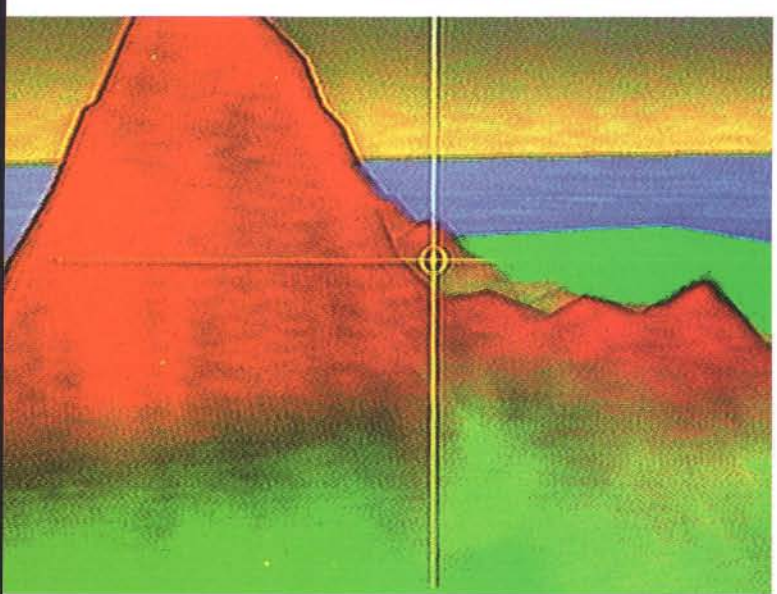
► best one yet, a compilation forwarded to us anonymously: "Craig Shergold is a 10 year old boy who is dying of cancer. Before he dies, he would like to set the world record for receiving the most Neiman-Marcus Cookie Recipes. You can help Craig by sending an irate fax to LEXIS-NEXIS demanding that they remove all traces of your mother's maiden name from their executive washroom wall. They will respond by sending e-mail labeled 'goodtimes' to the computer controlling Craig's life support equipment. When Felippe Linz, the technician operating the computer opens this mail, his hard drive will be overwritten with thousands of credit card invoices for $250.00, erasing the last bit of evidence that Hilary was seen on the grassy knoll when JFK was shot, thus allowing world domination by Bill Gates, and his tri-lateral commission cronies who are eating fried peanut butter and banana sandwiches in the black helicopters with Elvis." ☰III

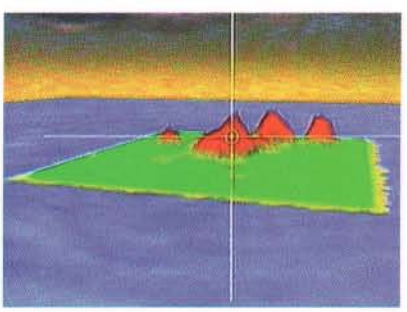
Mapping Science











Scientific research has its own geography, with well-explored continents and treacherous peaks. Although individuals are familiar with their own fields, no one can fit it all together.

That's why a technique for visualizing research holds such promise. Developed at Sandia National Laboratories, the algorithms will soon analyze connections between 3 million papers. This data is then represented as a three-dimensional landscape, where a mountain range signifying hot research issues in biology may connect to an area in physics by a narrow ridge.

What might we learn from such a map? "Connections that were previously hidden," suggests Chuck Meyers, project manager at Sandia. At the very least, a map of all research would function like a world map: it would give us a sense of perspective. – *Steve G. Steinberg*

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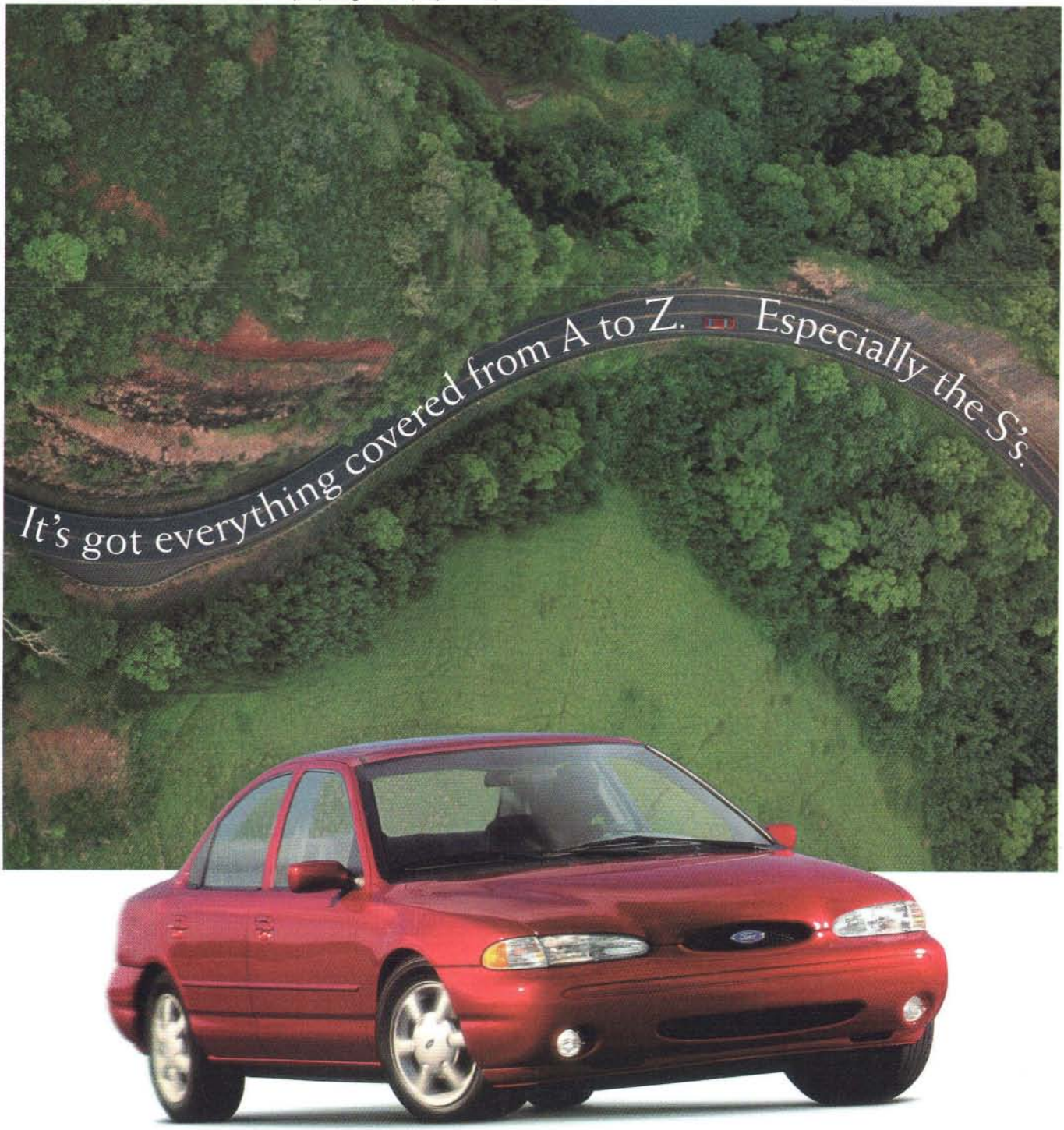

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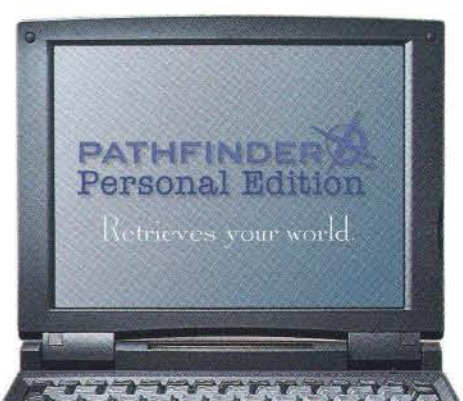

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THE NETIZEN

News You Can Abuse

TWA Flight 800 shot down by friendly fire. Bill Clinton's cocaine habit. The Net is doing more for paranoia and conspiracy than anything since J. Edgar Hoover's infamous FBI files. It's the golden age of "secrets." But the truth will out.

By Tom Dowe

I have a casual acquaintance here in Austin, Texas, who voted for Bob Dole in November. It wasn't because he felt particularly compelled to support Dole's "risky tax scheme," as the president called it ad nauseam during the final month of the campaign. It wasn't school vouchers or abortion or gays in the military. No, he'd read secret information about Bill Clinton on the World Wide Web.

One of my acquaintance's many email girlfriends, it seems, had steered him to Skeleton Closet *(www.realchange.org/)*, a clearinghouse for hot dish – some of it well corroborated, some not – on all the presidential candidates. There's Dole's "money laundering" and "illegal campaign financing." Ross Perot ("How crazy is he?"), Ralph Nader ("secret luxury home"), and Harry Browne ("a sellout") all get their due. From there my acquaintance moved on to sites like Truth At Last *(www.stormfront.org/truth_at_ last/clinton.htm)* and others, which offer the purported "full and complete" contents of the president's medical records, including – you really want to know this – "residual traces" of several venereal diseases, a bloodstream coursing with (ye gods!) Prozac, and the shocking (!) existence of a perforated septum from years of heavy cocaine use in the governor's mansion in Little Rock during the 1980s.

Personally, I don't have much interest in the condition, real or imagined, of Bill Clinton's septum. Still, you have to admire someone so determined to make his decision based on information he gathered himself. At least he was trying! Here was a fellow who, as far as I know, rarely reads newspapers or magazines, never watches the network news, and demonstrates only the most cursory knowledge of what we're all supposed to know are "the issues." But damned if he didn't sit down nightly and on weekends and catch up on the many "scoops" to be found on the Web. ►

Tom Dowe (tdowe@bigink.com) *is a regular contributor to* Amp (www.wrldpwr.com/amp).

www.wired.com/5.01/netizen/

This is not political coverage as usual. *Wired* magazine and HotWired have joined forces to produce *The Netizen*, a comprehensive magazine/Web site that appears daily, weekly, and monthly. You'll find ongoing investigations into the ideas and global realities that are transforming the fundamental structure of our national politics. Check out Rewiring *(www.netizen.com/rewiring/)*, a regular series of interactive forums mind-bombing the new millennium.

Lord knows, secrets – and their fellow travelers, paranoia and conspiracy – are no strangers to the American political landscape. In George Washington's day, it was the Illuminati. Turn-of-the-century Populists got halfway to the White House denouncing "the secret cabals of the international gold ring." In the 1950s, there were Reds under every bed. Richard Nixon had his "enemies." And yes, Virginia, Bill Clinton really does take his orders from the Pope. But you've never heard Peter Jennings, Tom Brokaw, or Dan Rather talk about that. Or about Clinton's nose. Because haven't you heard? The media are part of the conspiracy too!

Thirty years ago, historian Richard Hofstadter identified what he called "the paranoid style in America politics": "the sense that all our ills can be traced to a single center and hence can be eliminated by some kind of final act of victory over the evil source." Single sources of anything are emphatically not what the Net is about. And yet perversely, the Net is doing more for paranoia – a veritable Heinz 57 varieties of it – than anything since J. Edgar Hoover's infamous FBI files. It's the golden age of "secrets."

The Net is opening up new terrain in our collective consciousness, between old-fashioned "news" and what used to be called the grapevine – rumor, gossip, word of mouth. Call it *paranews* – information that looks and sounds like news, that might even be news. Or a carelessly crafted half-truth. Or the product of a fevered, Hofstadterian mind working overtime. It's up to you to figure out which. Like a finely tuned seismograph, an ever more sophisticated chain of Web links, email chains, and newsgroups is now in place to register the slightest tremor in the zeitgeist, no matter how small, distant, or far-fetched. And then deliver it straight to the desktop of anyone, anywhere who agrees with the opening button on the *National Enquirer* Web site *(www.nationalenquirer.com/)*: "I Want to Know!"

In the most recent election, that electronic grapevine has flourished, even as the much anticipated mainstreaming of Net politics raised barely a ripple. As my Netizen colleague Jon Katz recently noted, campaign 1996's most telling online landmarks were "big political sites, looming out of the ether like rudderless ocean liners, offering slick graphics, static information and worthless propaganda." And then in the middle of that, suddenly a screaming comes across the sky: The CIA imports crack. The Navy shot down TWA Flight 800. Clinton's on drugs.

Is this good news? Sort of. "The Net is terrible at propaganda, but it's wonderful at conspiracy," says Esther Dyson, who runs New York-based EDventure Holdings and chairs the Electronic Frontier Foundation. If you don't know Esther, she's being ironic: she'd rather it were bad at both. But at least now everyone can get the reality they want. And it can be as edgy as they like.

In a world of a thousand dueling realities, a mere two-party system starts looking about as compelling as three-network television. But when party platforms are perceived as mere propaganda, when Skeleton Closet offers truth and traditional media are cast as either dupes or shills, voting one's conscience becomes voting one's subconscious. It's Hofstadter country: Who will promise me my dream? Who'll protect me from my nightmare? Rationality doesn't have a lot to do with it.

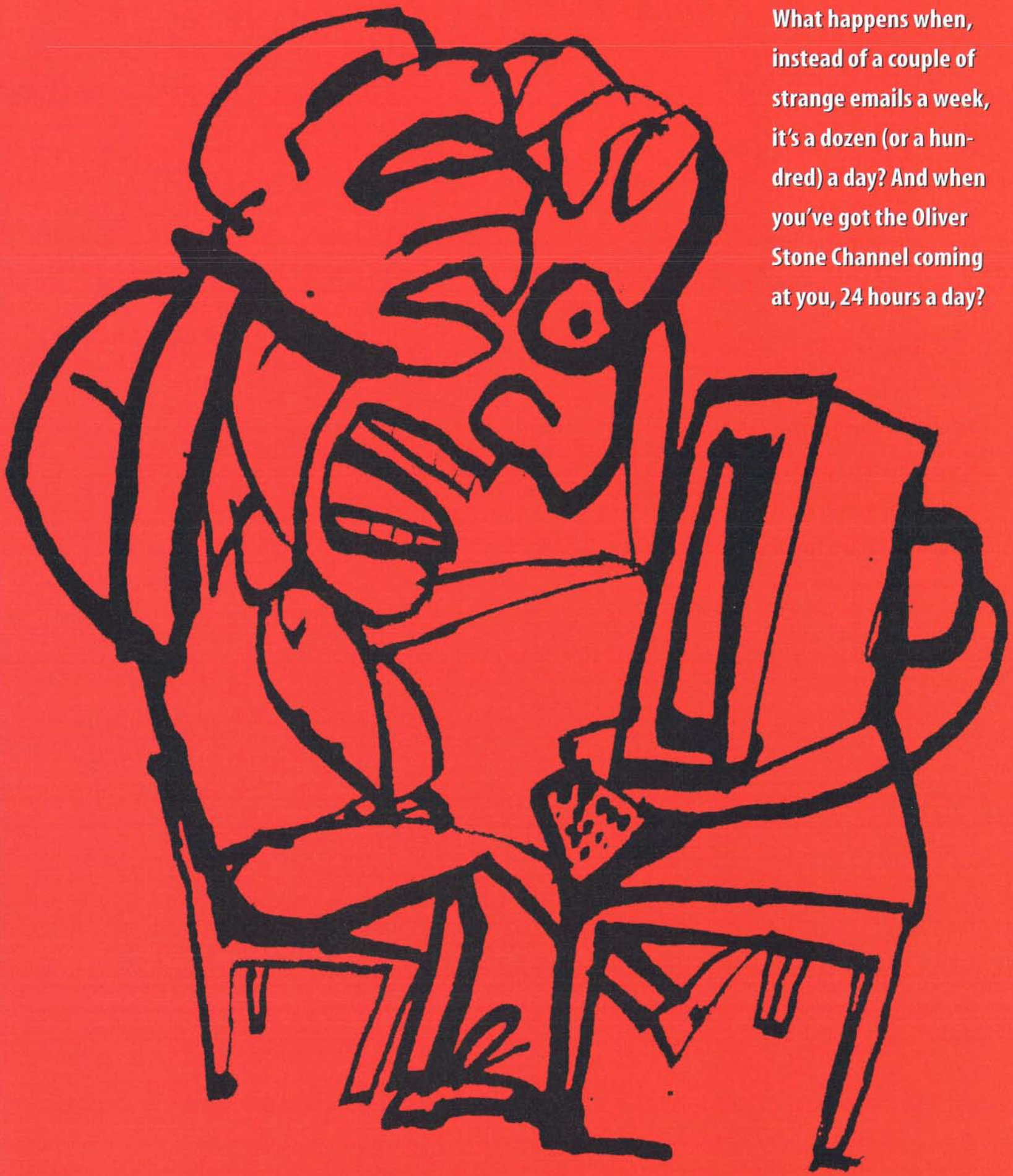
Still, there's a more immediate problem: what counts as "news" on the Net can be pretty much anything, regardless of provenance. And predictably, the bottom of the barrel is attracting most of the comment. It's a (slightly) more sophisticated version of the old bombs-and-kiddie-porn slander – the Net as cesspool for raving paranoid nonsense. The stuff is certainly there, but believers hope that the Net's informative powers will carry the day. Truth will drive out nonsense, or at least people will learn to recognize the difference. If only to protect themselves.

But there's also a pessimistic view: that the Net is Hofstadter's thesis writ uncomfortably large. That when the barriers come down, when people cease to trust the authorities, they – some of them, anyway – become at once more skeptical *and* more credulous. And on the Net right now – hell, in America – there's plenty of evidence for that.

Consider J. Orlin Grabbe, whose homepage *(www.aci.net/kalliste/)* is a one-man monument of do-it-yourself conspiracy theory. Grabbe's no fool: he's got a 1981 PhD in economics from Harvard and a résumé that includes extended stays at Barclay's Bank, the Wharton School of Business, and the National Bureau of Economic Research. Through his homepage, you can order a copy of his B-school-standard textbook, *International Financial Markets* (Third Edition, Simon & Schuster). Or you can read "The Phosphorus-Headed Missile and TWA Flight 800" and "Join the IRS: Deal Crack with Pay!" Here's the first nose again: "Our President does five lines a day." And Grabbe knows who killed Vince Foster – the Mossad!

At least he's original. Just as often, what you get on the Net are standard-issue Oliver Stone discards, dusted off and buffed to shine like actual journalism. Stunning revelations, for instance, that read like a wire service version of Pat Robertson's *The New World Order,* complete with references to the Illuminati and the Rothschilds. There's also David Duke's infamous rant *(www.duke.org/bilkmov.htm)* about the movie *Sgt. Bilko*. His complaint: the motor pool that Bilko ▸

 ILLUSTRATION BY SCOTT MENCHIN



What happens when, instead of a couple of strange emails a week, it's a dozen (or a hundred) a day? And when you've got the Oliver Stone Channel coming at you, 24 hours a day?

runs "is not made up of the majority elements" of the likes found in the original 1960s TV show. "Other than Bilko," the instant film critic says, "they were especially stupid, slovenly, weird, and unappealing as possible." So now you know.

That's family-values stuff, of course, compared with the neo-Nazi posturing of sites like Stormfront and Aryan Nations, which do everyone a favor by wearing their pseudo-swastikas like a Surgeon General's warning. No question where they're coming from.

Thrillingly "secret" rumors that arrive with the FYI plausibility of email are more difficult to parse. The purest kind of paranews was September's "friendly fire" eruption about TWA Flight 800. Ostensibly written by a high-ranking official of the FAA, the much-forwarded message – some versions changed hands half a dozen times in one day – made a suitably attention-getting claim: a US Navy guided missile cruiser had accidentally shot down the jet, and a cover-up was under way.

Did anyone ever find the ur-poster for TWA Flight 800's "friendly fire" email? It could literally have been anybody with an email account and a 2400-baud imagination.

Here was news you could use! Mainstream papers right up to *The New York Times* wrote serious stories about it. French and German TV crews fought for videotape of an FBI spokesperson discussing the theory. At one briefing session, after the fourth consecutive friendly fire question, the FBI's mild-mannered agent in charge, James Kallstrom, exploded: "The notion that this did happen and that we, hundreds and hundreds of FBI agents and police officers and all the other folks, are covering this up is nonsense. It's just not true." But then he would say that, wouldn't he? Said one skeptic, quoted in the *Times*: "The reason you haven't heard this is it's an election year." And whether or not you believed the message the first, second, or ninth time you received it, you had to think, at least once: "Now wouldn't that be a kick in the ass, if it turned out to be true ..."

That's where trusty brand names are supposed to help. Right, like retired ABC News correspondent Pierre Salinger? In November, two months after the initial furor, JFK's former White House spokesperson announced in a speech to French airline officials that – guess what – *he* had obtained a secret document confirming that Flight 800 *had been brought down by a US Navy missile*. Another global media alert ensued – at least until an alert CNN film crew amazed Salinger by showing him an email printout that matched his word for word. Which didn't stop CBS News from using the story to lead its *Evening News* – "primarily to knock it down," Dan Rather said later, in an interview.

One of the interesting formal properties of multiple email forwards is that there can be dozens of authoritative-looking addresses in the header fields, including .mil. But did anyone ever manage to find the "friendly fire" ur-poster? It could literally have been anybody with an email account and a 2400-baud imagination:

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>>>>>Fr: tdowe@whitehouse.gov
>>>>>Date: 1 December 1996
>>>>>Subj: FWD>re Silencing Wired Magazine
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Thomas Pynchon, in one of the more brilliant passages of *Gravity's Rainbow*, suggests that this type of essentially authorless divulgation prompts in readers "the self-induced orgasm." And indeed, a lot of paranews – regardless of its truth – functions like a skin mag at a sperm bank: something to mentally beat off with. *Pornographies of deduction*, Pynchon calls this: "*ahh*, that sigh when we guess the murderer ..." The Net invites you to extend Hofstadter's list as far as you want. The Illuminati did it. Or maybe the Freemasons. Catholics. Bankers and corporations. Communists. Fluoride. White devils. Politicians. OPEC. Trilateralists. Aliens. Democrats. Narcotraffickers. Religious cults. More aliens. The media. More bankers, more corporations. Militias. Republicans. More aliens.

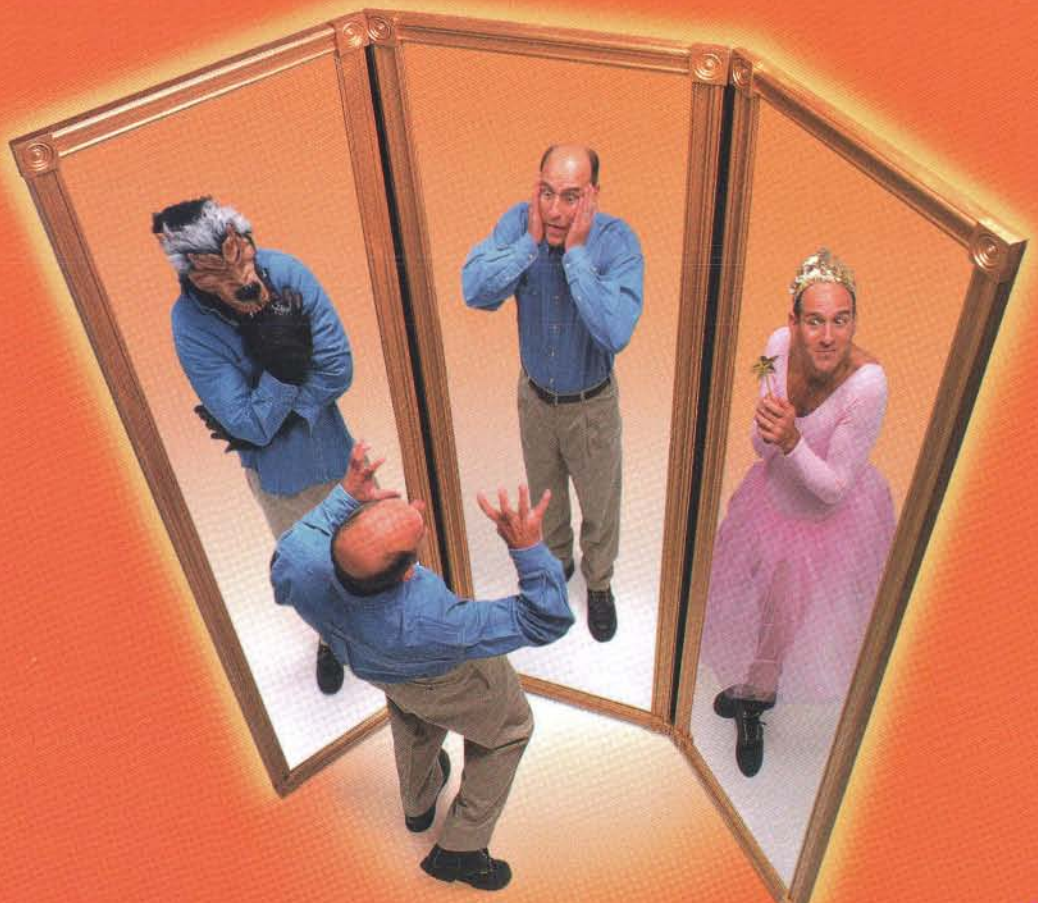
The CIA.

Those three little letters, bursting with paranoid promise, were at the heart of another, more serious Net-based story that erupted in Washington in late October. Bruce Kletz, ex-marine and novice publisher, was working with two former CIA analysts on a book, *Gassed in the Gulf*, that accuses US officials of covering up proof that more than 20,000 American troops were exposed to Iraqi chemical weapons during the Gulf War. Some of that proof, Kletz says, was contained in 226 declassified documents that had been posted on Pentagon's Gulflink Web site – until they were quietly removed, Pentagon officials say, at the CIA's behest.

Kletz, who had his own copies of the missing documents, jumped in and announced he would post them on the Web site run by his company, Insignia Publishing *(www.insigniausa.com/)*. The mainstream media piled on: feisty publisher takes on the Pentagon and the CIA. When I called him, Kletz's saga was in *The New York Times* and the top story on AOL. "I'm a relatively inexperienced publisher sitting in my basement doing this," said Kletz, more than a little awed. "In the past 36 hours, I've appeared on or been approached by every major television network."

The story has a happy ending – sort of. Tail between legs, the CIA and Pentagon quickly 184 ►

DON'T GO SCHIZO.



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Edited by Tim Barkow

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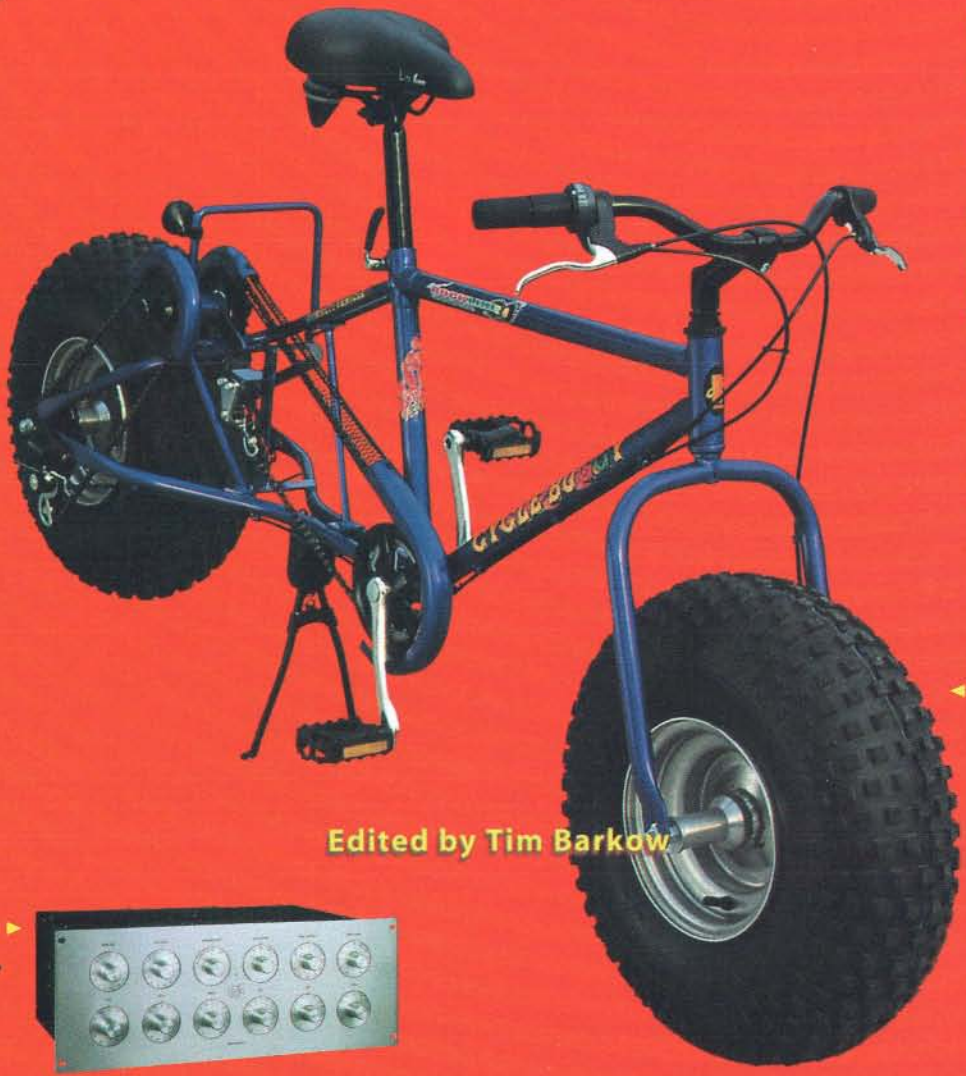
Bugs

This treasure box looks unusual at first glance, but the story of its creation is as fascinating as the finished piece. Formed from the cast of an elephant beetle, the head, when pressed down, releases the wing cover of the box, revealing a hidden compartment for storing your trinkets. The bug's exoskeleton was re-engineered to perform this trick. And while the box is beautiful, knowing its origins highlights its macabre appeal. Beetle treasure box: bronze, US$510; silver plate, $610; gold plate, $695. Nikolas Weinstein Studios: +1 (415) 587 5987.

Fatties

While mountain bikes have mutated into hybrids, designed to perform better on the road, they look wimpy. What's the serious rider to do? The Rockline Cycle Buggy may be the answer. With a pair of ATV-like fatties, the Buggy looks geared for serious off-roading but is actually built to provide a soft, cushioned ride on paved surfaces. Its extreme looks are complemented with a light chro-moly steel frame. For those who can't stand riding the fence, the Cycle Buggy might look like a hybrid, but it certainly won't cruise like one. Rockline Cycle Buggy: ¥145,000 (US$1,350). Oshima: +81 (568) 31 6261.



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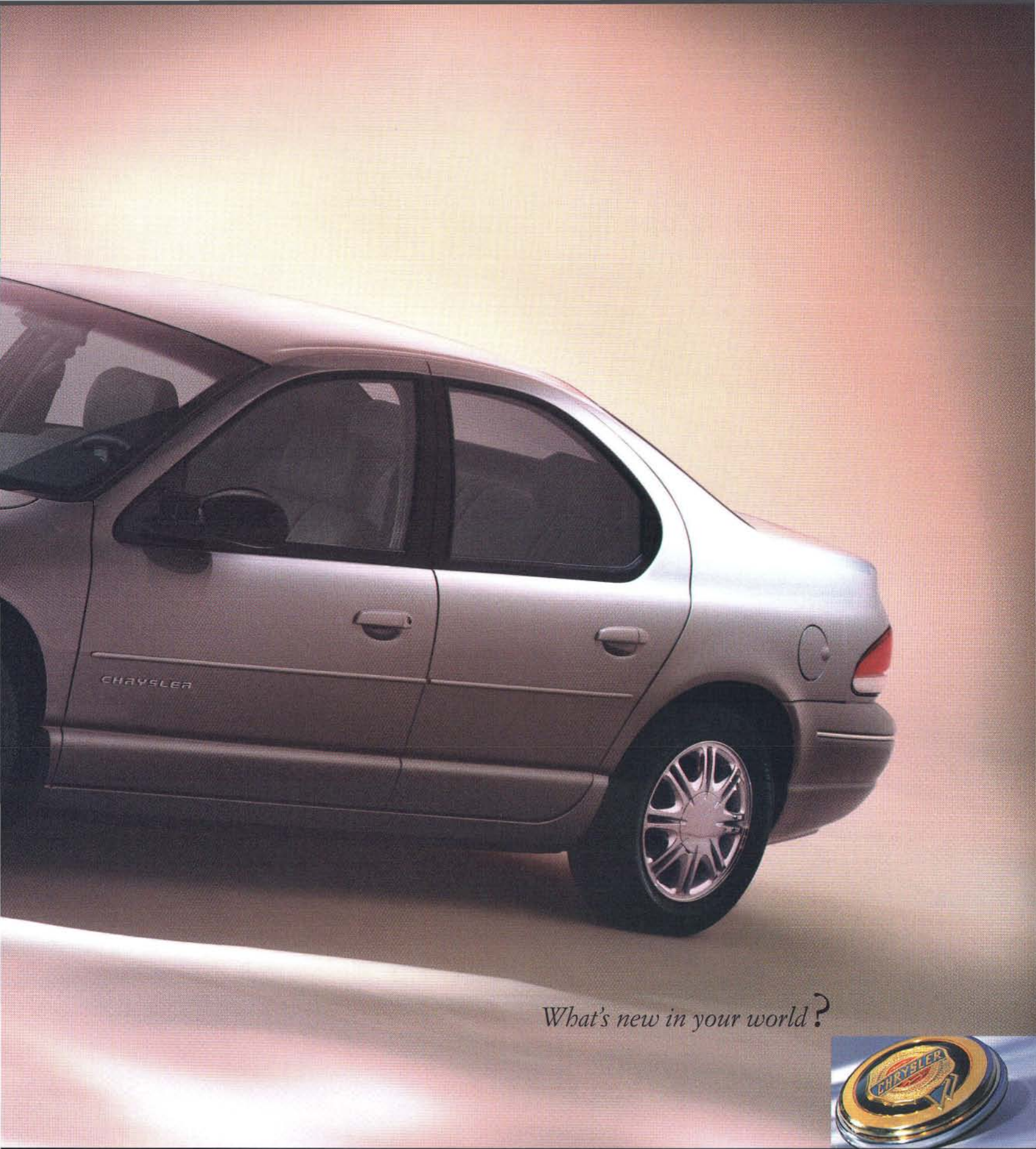

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Detach

One of the great things about a walkman is the sense of detachment it gives you. But you often can't escape the cold reality of the wires tethering your ears to the body of the machine. Sony's finally fixed this annoyance: the WM-WX1 sports a wireless connection, linking the main unit to the small, Mickey Mouse-looking dingus that holds the earphones. This mini-receiver simply clips onto your shirt collar, freeing you from worrying whether you're about to catch the headphone wires on an obstacle and rip new holes in your tender ears. WM-WX1: ¥27,000 (US$250). Sony: +81 (3) 5448 3311.

Tops

It doesn't do anything fancy – except fold. Origami's times table is in many ways the perfect table for these times. Its foldable design makes it easy to ship, a snap to set up, and simple to pack up and move. The tabletop includes a wire port for tucking away computer cables, and you can gracefully add the Keyster, a keyboard tray for the ergonomically inclined. Colors? Origami paraphrases Henry Ford: Whatever color you want, so long as it's black. times table: US$299. Keyster: $99. Origami Inc.: +1 (206) 781 2659, on the Web at www.timestable.com/.

Burled

As evidenced by the rash of contempo computers, users want something that blends into their homes better. The Executive from Asuko is an entirely different animal. Custom-built from high-quality woods, the Executive brings a special warmth and elegance to an otherwise cold technological object. Even the mouse is fashioned from dead tree parts. Complemented by a pair of 120-watt speakers, the Executive not only makes a statement, it makes a loud one. Asuko Executive: ¥880,000 to ¥1,350,000 (US$8,150 to $12,500). Asuko: +81 (3) 3944 9466, www.asuko.isfnet.ad.jp/p2.html.

Ample

Rogers has been making some of the world's finest loudspeakers for years, carrying the torch for quality British hi-fi. Although the company has finally decided to branch out and produce an amplifier, it hasn't lost its cool. No vanilla electronic circuitry for these folk; when Rogers makes an amp, it's good old-fashioned tubes only. Best of all, Rogers has wrapped its E20a and E40a in drop-dead audio-nerd black boxes – with canopies of silver grill that shyly reveal their gorgeous inner workings. Rogers E20a: £1,090 (US$1,660). E40a: £1,900 (US$2,900). Rogers: +44 (181) 640 2172.

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Once in a while, something comes along that challenges assumptions about how games can be built. Brain Warp is deceptive: at first you try twisting or pushing the knobs. But it is simply rotated – a weighted ball inside settles to the bottom knob, closes a circuit, and registers the knob on top as your selection. And the single selection button turns off automatically. What could be simpler? Well, add up to six games with up to six players, and things get difficult quickly. Brain Warp: US$24.99. Tiger Electronics Inc.: +1 (847) 913 8100.

Focus

The Great Gatsby's *Dr. T. J. Eckleburg may have made a bigger name for himself had he invented the Eye-Control Focus System, but he didn't – Canon did. With the ability to function in both vertical and horizontal modes, the EOS Elan IIe's eye-controlled focus won't leave you wandering a wasteland of blurred vision. Using infrared-emitting diodes, the camera "learns" the shooter's pupil-focusing points. Purists, worry not: the Elan's traditional SLR design can also revert to full manual and programmed image modes. EOS Elan IIe: US $800. Canon USA: (800) 828 4040, on the Web at* www.usa.canon.com/.

Effuse

***Computer interfaces have continually fallen short of expectations, but building superior input devices at home has been next to impossible. Until now. The I-Cube System communicates through MIDI, patching your PC to a variety of sensor inputs that respond to changes in light, temperature, touch, and proximity. I-Cube has been used by artists and can help involve more of your senses in your computing experience. I-Cube Digitizer: US$595. Infusion Systems: +1 (604) 253 0747, on the Web at* www.infusionsystems.com/.**

Wrest

***The mouse is turning out to be a bane for heavy computer users. Easy to pick up, the mouse may be responsible for more RSI troubles than its partner, the keyboard. The Mouse "Surf" Board may help. It sits in your lap, providing a smooth surface for mousing and easing strain by keeping your wrist in a "body neutral" position. (But remember to give your legs a break as well.) The Mouse "Surf" Board: US$15. Neutral Products Inc.: on the Web at* www.neuergo.com/surfboard/.**

***Thanks to Chris Rubin, Richard Overton, Jenny Butler, Megumi Ikeda, Tadashi Ibi,* Wired *Japan, and* Wired UK.

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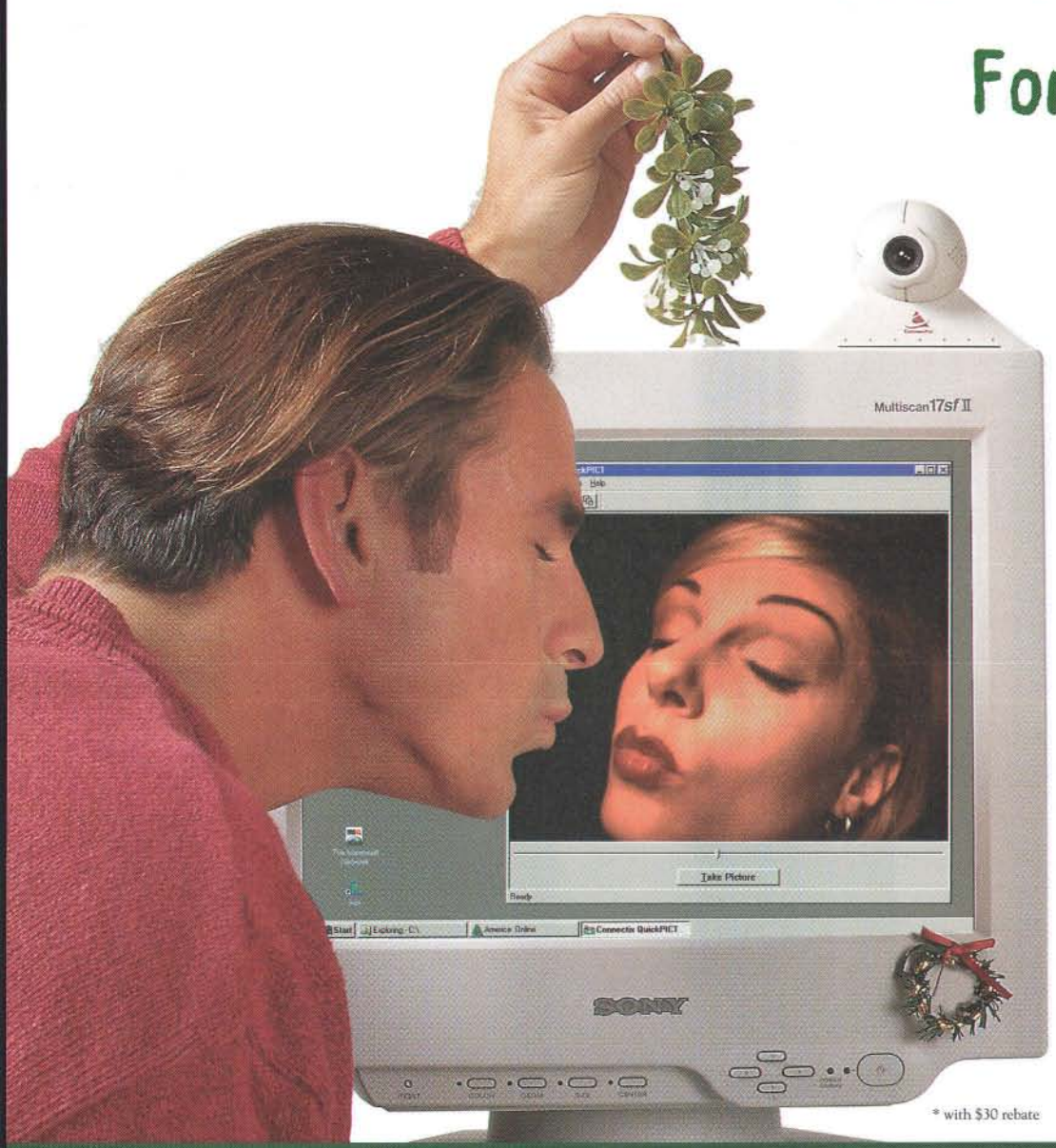

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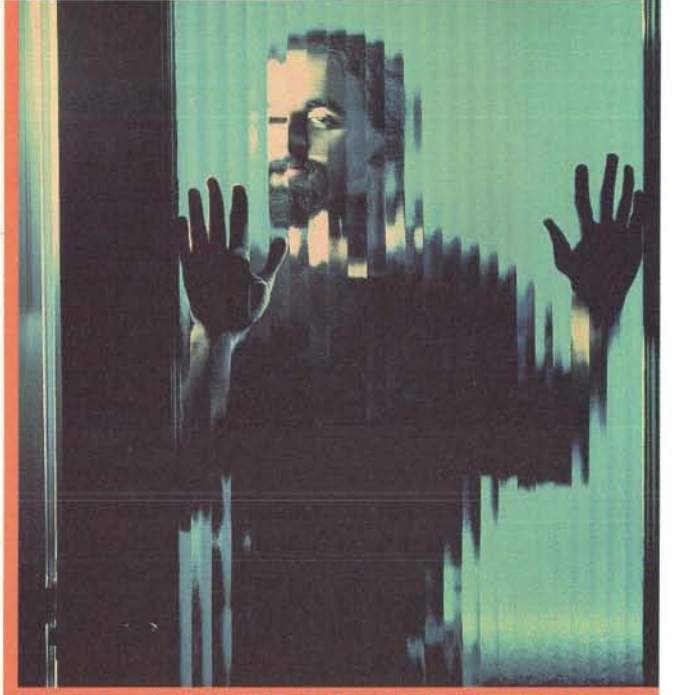
Making Privacy Pay



Sameer Parekh: playing hide-and-seek with online snoops.

The National Security Agency and the FBI are unleashing bloodhounds in cyberspace, but Sameer Parekh wants to help you throw them off the trail. He sees it as a race against time. "The government is trying to outlaw privacy. We need to put privacy-enhancing technology in place as soon as possible. If we get there first, it won't make any difference what laws they pass."

Sameer's elfin face looks even younger than his tender age of 22. And while he is usually polite and soft-spoken, his steely resolve makes itself evident when he discusses his beliefs about civil liberties. "The reason I've made a business out of privacy is that otherwise it's just a hobby. And hobbyists can't create an effective, reliable infrastructure for personal privacy."

Trying to keep a low profile? C2Net is in business to "preserve privacy on the Internet."

Sameer means business – both figuratively and literally. His business, in this case, is C2Net, a start-up software company and Internet service provider. C2Net's stated mission is to "preserve privacy on the Internet." If you're trying to keep a low profile, C2Net can set you up with an anonymous Internet account, a pseudonymous server, or a remailer interface.

Why all the fuss about privacy? Whenever you surf the Web, you leave behind all sorts of juicy information about yourself. Web site sysops – and anyone lurking between you and the site you are browsing – can find out what type of computer you're using, your email address, and what other Web pages you've visited. Hardly the kind of stuff you'd want a direct marketer or government snoop to know about.

One of Sameer's remedies for this information hemorrhage is called the Anonymizer – a site at *www.anonymizer.com/* that enables you to browse the Web with complete anonymity. Best of all, this privacy won't cost you a dime. While Sameer looks for advertisers to carry the water for anonymous users, C2Net is supporting the Anonymizer as a public service.

Sameer learned about controversy at an early age. As a teenager, he campaigned against drug laws and published an antidrug law newsletter. His free speech foray was rewarded with regular visits to the principal's office. Despite the pressure, Sameer continued to make waves by publishing his newsletter.

And today, he's still making waves. Of course, every time some government comes up with a new way to diddle with your privacy, Sameer will have to think up a new way to stop them. But the smart money is betting on Sameer.

– *Sandy Sandfort*

Sweating Out Your Drug Test

The next time you see someone wearing an adhesive patch on their arm, don't assume it's there to help them quit smoking. PharmChek, a drug-detecting patch developed by Sudormed Inc. of Santa Ana, California, absorbs molecules of substances like marijuana, PCP, amphetamines, opiates, and cocaine given off in perspiration.

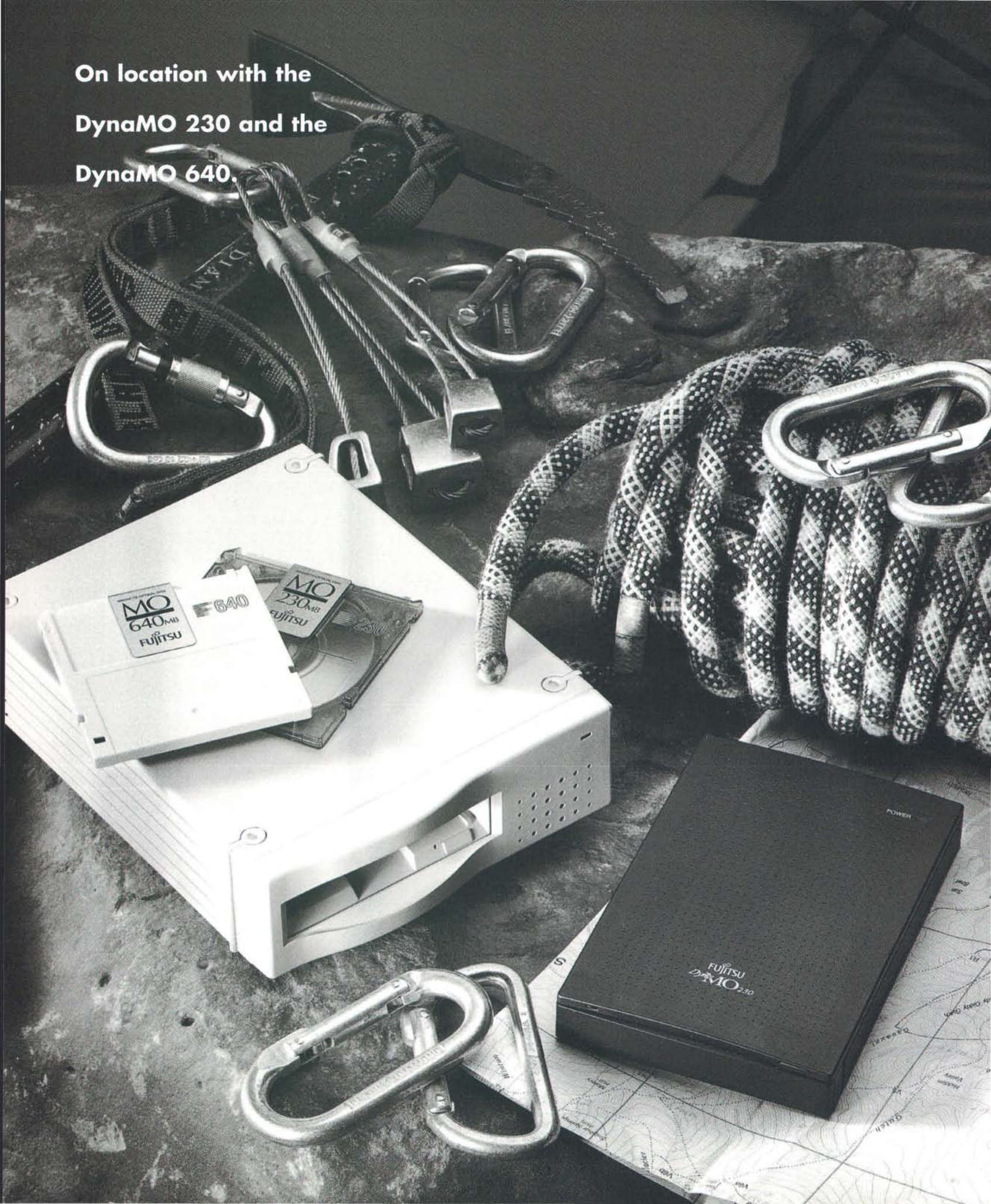
Users wear the tamper-proof patch for up to seven days, when it is sent to a lab for testing. Don't bother trying to escape detection by refusing to exert yourself for a week. "You're always sweating. You'll lose 600 milliliters just sitting at room temperature for 24 hours," says Don Schoendorfer, vice president of research and development at Sudormed.

PharmChek is being evaluated in 36 federal probation sites across the US. But for now, if the idea of getting caught toking up makes you sweat, then avoid getting slapped with a PharmChek patch.

– *Dave Cravotta*

What? Me worry?

PHOTO ABOVE: JOHN HARDING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Follow That Car!

Forget about hailing a cab at the Minneapolis-Saint Paul International Airport. Officials there have refined a computerized taxi dispatch system that eases traffic congestion and cuts down on squabbles between competing cabbies.

But having their every move tracked over a fiber-optic network doesn't sit well with some old-school drivers. "Our movements are controlled by the machine, and I don't like it," says an emphatic Syed Hussain.

Big Brother syndrome aside, however, most drivers don't mind having transponders mounted on the windshield behind their mirrors and enjoy not having to physically hold their place in a line of waiting cabs anymore. "Everybody knows we need the computers now," says Sammy the Greek, a 41-year veteran driver of the Minneapolis airport circuit. "Anybody who doesn't like it is wrong in the head." – *Timothy Broeker*

Hey, buddy, no cutting in line.

Suburbia Meets the Final Frontier

H. Paul Shuch is looking beyond New Jersey for intelligent life.

Is the banality of ordinary television programming getting you down? Why not try tuning in to signals from an extraterrestrial civilization with your backyard satellite TV dish?

When the US Congress cut off funding for NASA's search for extraterrestrial intelligence (SETI) in 1993, professional researchers scrambled for private financing. The congressional move also led to the formation of the SETI League, a group of amateur radio astronomers headquartered in Little Ferry, New Jersey. Executive director H. Paul Shuch often livens league meetings with a song: "My satellite antenna is pointed at the sky/ But I'm not watching television, let me tell you why/ I'm searching for existence – proof of any alien race/ By sifting through the microwaves that fall from outer space."

Using a standard backyard satellite TV dish, a microwave receiver, a pre-amplifier, and a computer, Shuch has been scanning the cosmos for signs of extraterrestrial intelligence. A professor of electronics at the Pennsylvania College of Technology (part of Penn State), he has taken a leave of absence to head the SETI League.

"For about US$2,000, you can build yourself a really good SETI station," Shuch says. "You can pick up MTV at the same time you listen for extraterrestrial intelligence because the signals don't interfere with one another – you just stick a second feed horn onto your dish."

The SETI League's grand goal is to develop Project Argus, its coordinated search, into a worldwide network of 5,000 dishes that will scan the sky for alien beacons arriving from as far out as 200 light-years. With 387 members now in 17 countries, the league has 24 stations online or under construction.

One station is operated by Rachel Tortolini, a family practice physician in Oahu, Hawaii. "I was just looking for a hobby to take my mind off medicine," she says. "I mostly buy surplus. I picked up a 10-meter diameter dish at scrap metal prices."

Backyard amateurs are searching for space aliens using satellite TV dishes.

Tortolini says, "The dishes remind me of big flowers pointing their petals to the skies, waiting to receive whatever's out there. There's nothing between my dish and the end of the universe." – *Dave Cravotta*

Jargon Watch

Domain Dropping Giving someone you want to impress your hippest email address, even if it isn't where you usually pick up your mail. "Kevin is such a domain dropper. He gives people his Well address, but he actually gets his mail on AOL."

Eurominutes Scenes in syndicated TV shows that are included in foreign versions but cut from US episodes to increase the time available for commercials. "The scene where Rachel gets to Paris is only in the eurominutes."

NASCII Art Porno images rendered in simple ASCII text.

Serendipity Search An Internet search that uncovers interesting and valuable information that was not intended in the original search. "I found this really cool site on tiki collecting during a serendipity search."

Tetwrist A repetitive strain injury acquired after extended play of addictive puzzle games like *Tetris*.

Tip o' the earflap cap to Jesse Freund, Jill Gillham, Carla Sinclair, David Smith, and Andy Snevets.

– *Gareth Branwyn* (jargon@wired.com)

PHOTO ABOVE: ERIC SCHAKENBERG/FPG

An Australian body painter has invented the liquid condom.

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Your throat is swollen, and it hurts like hell. At the doctor's office, a culture swabbed across a computer chip reveals "strep throat" within seconds. The technology may resemble a *Star Trek* tricorder, but it's here – now.

Invented by San Diego-based Nanogen, the system – dubbed APEX – can detect multiple diseases on the spot. It works by placing a patient sample on the surface of a special Nanogen chip. Woven into the surface of the chip are DNA strands called capture probes that interact with patients' DNA, triggering a positive reading if the probes detect DNA that match the illnesses – like strep throat – they're programmed to detect.

The APEX scanner interacts with patients' DNA to detect diseases on the spot.

It's a marriage built in biotechnology heaven. "Right now, you go to the doctor's office with a sore throat, he takes a swab, hands you some antibiotics, and tells you to call in two days," says Nanogen president Tina Nova. "With APEX, the sample can be placed on the chip, and within minutes it will test for strep culture or any other respiratory disease."

Nanogen's APEX scanner isn't as flashy as Doctor McCoy's medical tricorder – requiring direct contact with human tissue instead of a casual wave over the body – but Nova nevertheless predicts it will revolutionize diagnostic medicine. "We're using electronics as the basis of our science," she says, adding that her technology could pose a competitive threat to conventional test tube laboratories, where results can be late and are occasionally wrong.

Nanogen broke onto the scene three years ago, and the not-yet-public company is still waiting for its invention to go to town. But that's normal for the US$10.8 billion biotech industry, where research and development can often last a decade or more, and cost millions, before products are ready to hit the market. The APEX system still must pass an FDA testing regimen specially designed for the hybrid silicon-DNA technology. Nova predicts a lab-ready prototype by 1997 and a marketable version a few years later.

Nova's third venture in eight years, Nanogen has made her the envy of fellow scientists and the darling of biotech investors. "My specialty is the start-up phase. They know I'll work 12 hours a day, eight days a week to get it right."

– *Lauren Barack*

The Hub: rebooting the social context for music making.

The Network Is the Instrument

What happens when a bunch of high tech musicians link their computers together? You get The Hub – the most wired band around. Since the late 1980s, these six musicians have been using networked MIDI systems to create spontaneous digital musical productions. Inspired by jazz groups like the Art Ensemble of Chicago and electronic pioneers John Cage and Xenakis, The Hub produces a strange mixture of improvisation and programmed music.

During Hub jams, the musicians write music programs using their own software, and a central "hub" computer coordinates the interaction. One machine may send out a melody while another delivers the rhythm or pitch. Says Tim Perkis, a software developer and Hub member, "The Hub is about redefining a social context for music making."

The Hub is evidence that the medium is indeed the melody – the networked "instruments" invent the process while the musicians input the variables. How does the music sound? Well, let's just say you've never heard anything like it. – ***Hayley Nelson***

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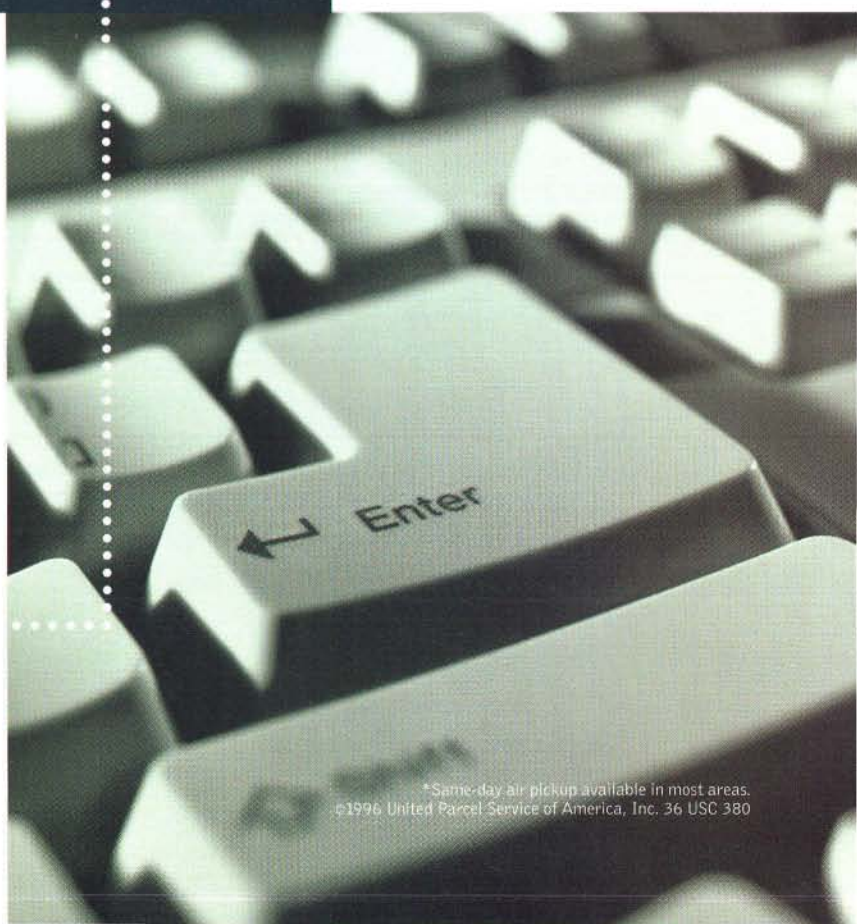

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The huge leap from corporation to nation-state has finally been taken.

Yes, Cuervo Tequila bought an island off the coast of Tortola and declared independence. Once inhabited by the Arawak and Caribe Indians, the island was later "discovered" by Columbus, though it sat empty for much of the last 300 years. After Cuervo bought the place for an undisclosed sum, the company petitioned the United Nations for nation status. When it was ignored, the company held a protest rally. Later it tried to send a volleyball team to the Olympics, and when ignored again, Cuervo held another rally. Meanwhile, the island is no longer empty. Today it is margaritaville and without a doubt, one of the biggest advertising gimmicks in history.

Cuervo calls it "the spiritual homeland for the Cuervo lifestyle." Its plan for the coming year is to establish itself as a legitimate island nation – a process that so far has included setting up an Office of Propaganda, appointing MTV's Dan Cortese as ambassador to the United States, and declaring an iguana named JC Roadhog as mascot.

Sure, the campaign is clever. When Cuervo comes to your Friday night bar with a big banner that reads, "Don't Just Stand There, Defect Now!" it's tempting to say "Hell yes! Where do I sign?" Yet the whole concept also raises the chilling prospect that someday multinationals will become governments, make their own laws, and rule whole countries by corporate fiat.

But for now, Cuervo isn't interested in such nagging concerns. Ask Scott Mueller, Cuervo's public relations manager, what he thinks of the politics of the gesture, and he glibly replies, "Our political platform is frozen or on the rocks."

The huge leap from business to nation-state has been taken, but it's unlikely many people will notice or care. That's largely because it's funny, it's Cuervo, and shucks, we've all been drunk on Cuervo. But what about the next corporation that decides to go on an imperialist buying spree? What about the company without a sense of humor, that isn't ecofriendly, and that wants to do a lot more than party? What then? – *Steven Kotler*

Fantasy Island: deep in the West Indies, just off Madison Avenue.

Wired Top 10

Women's primary online activities

1. Email	29 percent
2. Web surfing	24 percent
3. Education/reference sources	13 percent
4. News and information	9 percent
5. Business-related activity (excluding email)	8 percent
6. Real-time chats	5 percent
7. Entertainment	4 percent
8. Computer-related activity (software downloads, tech info, et cetera)	2 percent
9. BBS and forums	2 percent
10. Newsgroups	1 percent

Note: Ranking is based on multiple survey data and analysis of primary and secondary research of women's online behavior. Percentages reflect what women rated as their Number One online activity.

Source: *Women Online Report*, Jupiter Communications, +1 (212) 780 6060, *www.jup.com/*.

– *Gareth Branwyn*

Glendinning: gone native.

Luddite Grrrl

"Our entire civilization is addicted, meaning it cannot function without its use of all technologies," says neo-Luddite social critic Chellis Glendinning.

Glendinning, author of *My Name Is Chellis and I'm in Recovery from Western Civilization*, is a psychologist and leader in the field of ecopsychology, which holds that the mind and nature are inseparable. She insists technology isn't all it's cracked up to be. "Native peoples are far more healthy and integrated, and they function on a higher level than societies dominated by technology."

The author/psychologist doesn't suggest we all run to sign up for recovery programs like Technologists Anonymous. She believes the cure for techno-addiction lies in deep healing through culture creation, political action, and challenging established social structures. Funny, that sounds like something we might say. – *Marissa Raderman*

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The Future of Garbage

You've heard the hype. We asked the experts. Here's the *real* timetable.

"Garbage in, garbage out," goes the old maxim. And in the US, that garbage adds up to 190 million tons per year. Where does it all go? Into landfills and incinerators, for the most part. But as the dumps fill to capacity and environmentally dangerous incineration is phased out, consumers and producers turn to waste-management professionals for answers. Taking out the garbage has become a complex, controversial, and lucrative undertaking. *Wired* asked five experts to talk trash.

	Mandatory Residential Recycling in US	Source Reduction Catches On	Safe Disposal of Nuclear Waste	Launching Garbage into Space
Heenan	unlikely	now	now	1963
Hudson	2005	2020	2005	unlikely
Loquvam	unlikely	2050	unlikely	unlikely
Vela	unlikely	2020	unlikely	2040
Wilt	2008	1998	unlikely	unlikely
Bottom Line	unlikely	2017	unlikely	unlikely

Bill Heenan
president of the Steel Recycling Institute

Dropping that empty soda can into a Hefty bag instead of a green bin probably won't land you in jail anytime soon. Wilt, however, remains optimistic about the recycling trend; if commitments like the EPA's recent pledge to increase the national recycling rate to 35 percent by December 2004 are successful, she says, "the US may move toward mandatory recycling legislation early in the next century." Hudson predicts that we'll need another crisis, "such as oil supply restrictions, to get the political ball rolling." But according to Loquvam, incentive programs – such as a variable-can rate system – are more likely to cut the volume of waste than recycling laws are. "Families would get charged by the size of the garbage can they put outside during the week," she says. "You get down to a smaller can by recycling, backyard composting, and buying smarter."

Barclay Hudson
waste management consultant, Thunder Bay Consulting

Mary Loquvam
waste management consultant; former executive director of Waste Not Inc., a nonprofit recycling company; former owner of J and S Salvage, a Ventura, California-based recycling company

Lupe Vela
program manager of the Integrated Solid Waste Management Office for the City of Los Angeles

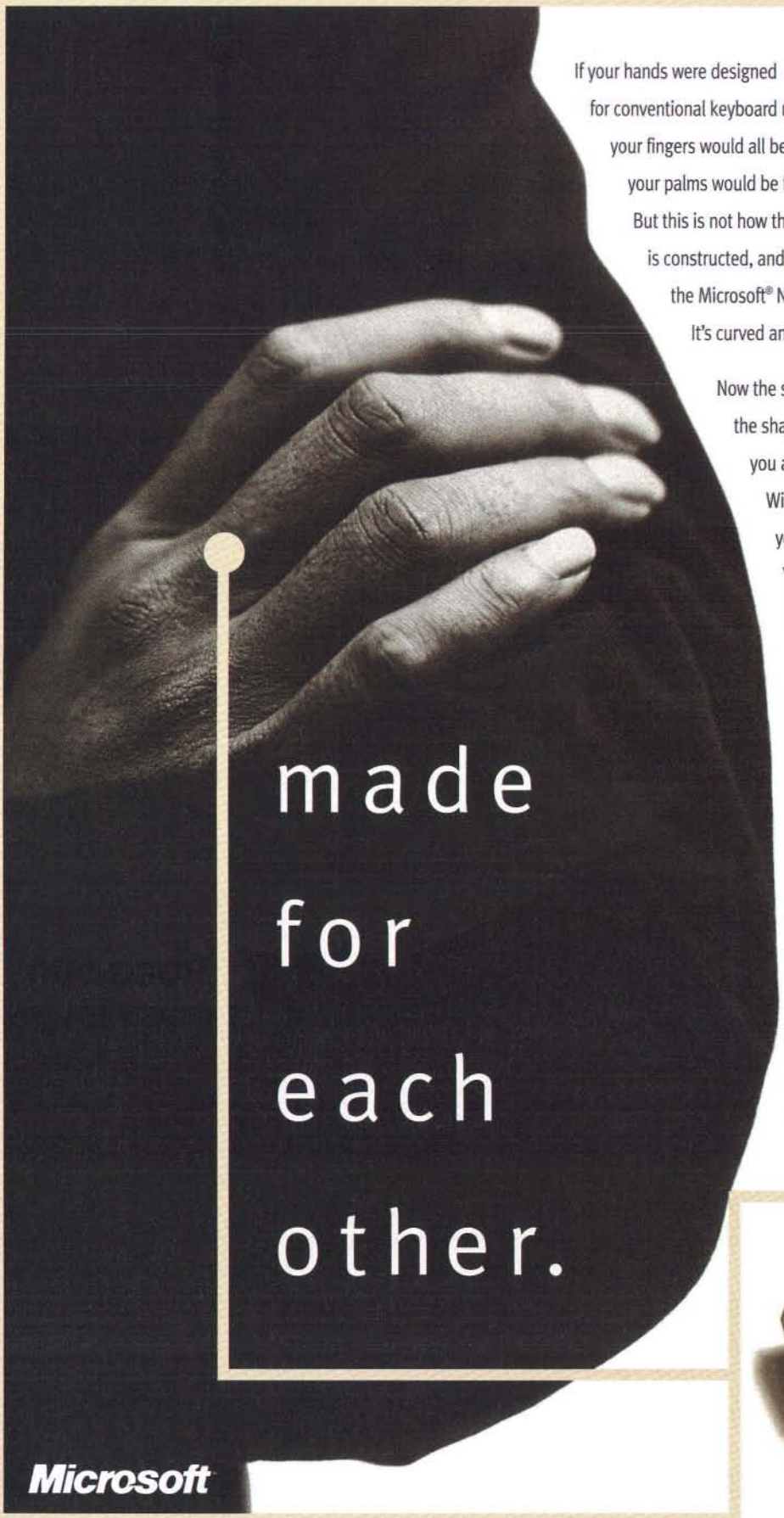
Catherine A. Wilt
senior research associate of the Energy, Environment and Resources Center, University of Tennessee, Knoxville

Until recently, recycling was primarily the province of hippies and homeless people. Is it only a matter of time before source reduction – that is, reducing our amount of garbage – catches on, too? According to Heenan, the concept is already in effect on the manufacturing side of things, where source reduction is considered cost reduction. "This can be seen in the 33 percent decrease in the amount of material used in a soup can today compared with just 20 years ago," he says. Meanwhile, Wilt and Vela think today's schoolchildren will grow up to be greener consumers with a "recycling ethic." Loquvam, however, isn't convinced that the cultural mind-shift needed to reduce waste is coming anytime soon. "Source reduction and sustainable development," she says, "are anathema to our consumer society."

According to most of the experts polled, "no nukes is good nukes" when it comes to the safe disposal of radioactive materials. Even once proper waste-management methods are decided upon, Hudson thinks the high cost of disposal will be built into the price of products, sharply reducing the use of nuclear materials. Holding his ground, Heenan says, "Luckily for nuclear reactors across the world, steel drums are available to safely dispose of wastes in salt mines in a benign fashion." Wilt agrees, for the most part, that our current disposal options for low-level radioactive waste are considered safe and adequate, but it's a whole different ball game dealing with high-level waste isolation. "How safe is safe?" she asks, noting that 10,000 years or more are required for radioactive decay. Answering that life or death question, Vela replies, "There is no safe disposal of nuclear waste, only a holding pattern."

Why not just pack tons of trash into a rocket and shoot it into the sun, the ultimate incinerator? Not a bad idea, according to Vela. "This will be true cogeneration," she says. "Energy created by solar incineration will return to Earth as sunlight." Of course, cost is always an issue, and it becomes a massive one when talking about space missions. "We won't launch trash into space until the cost per ton to get it there is competitive with the cost to landfill it," says Loquvam. At present, she notes, it costs US$35 per ton to landfill garbage in Los Angeles County and approximately $20 million per ton to have a payload blast into space aboard the shuttle. On the other hand, Heenan points out, the process has already begun: "As we leave a trail of unmanned rockets floating above the atmosphere, we already are launching garbage, which, by the way, would be highly recyclable if we could get it out of space."

3-D DATA SET: VIEWPOINT DATALABS



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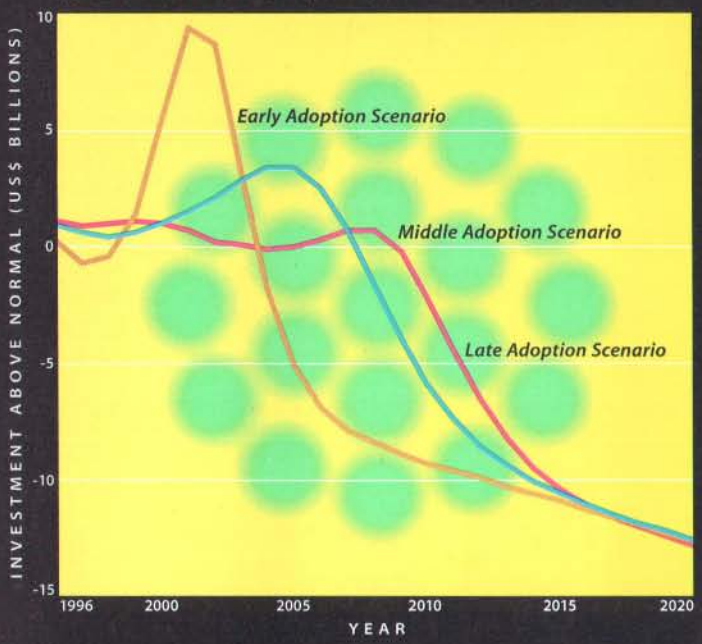
The Fiber Investment

Though local exchange carriers, like the RBOCs, are waiting for high-bandwidth demand to emerge, the time for fiber investment is now. Why waste money maintaining the old copper networks? Early adopters will enjoy significant savings by completing conversion in 2007, while middle and late adopters finish conversion in 2016 and 2018, respectively.

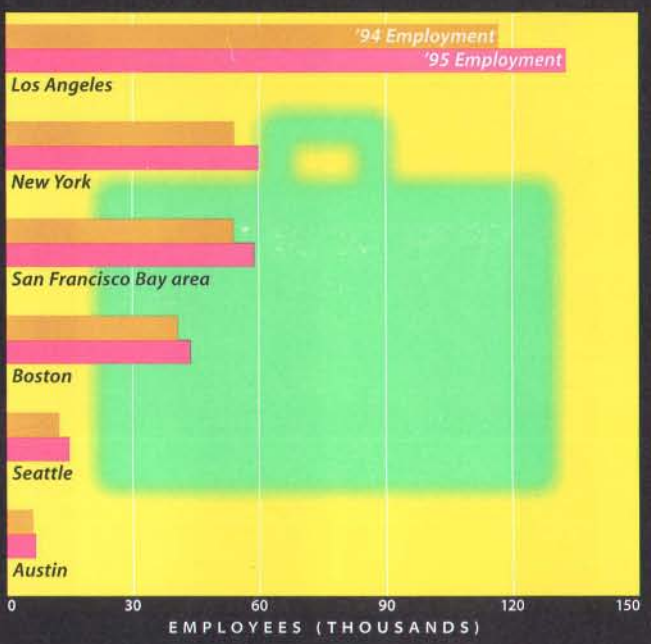
SOURCE: TECHNOLOGY FUTURES INC., *ADVANCED VIDEO SERVICES*



Multimedia Employment

Even though the CD is a widely disparaged medium, multimedia has grown into a thriving business. Total 1995 US employment in this industry is estimated at 1.1 million, growing at a rate of 13.5 percent. Most of the large markets include the usual suspects, but the rise of Austin and Seattle might signal a shift toward new digital hotbeds. Finally, some new places to live!

SOURCE: BAY AREA ECONOMIC FORUM



The Cost of the Network

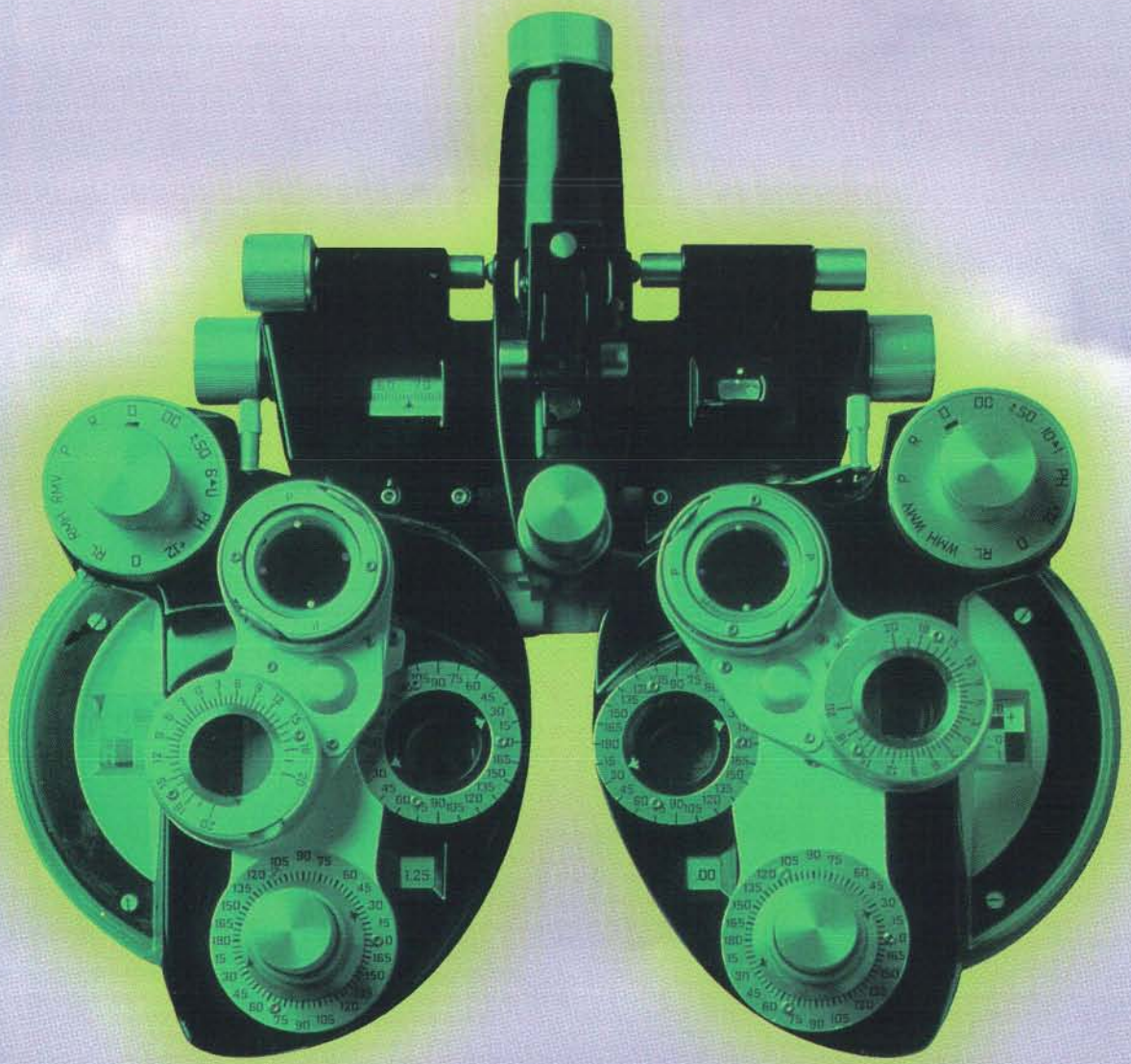
As the Internet invades the workplace, businesses have become more reliant on their networks, increasing their vulnerability to attack. Computer crime losses hover in the billions and aren't expected to decrease anytime soon. The main problem isn't hackers, though – it's employees who misappropriate information they've culled from company computer systems.

SOURCE: AMERICAN SOCIETY FOR INDUSTRIAL SECURITY; COMPUTER SECURITY INSTITUTE

Retail Pet Food Sales

Dog and cat foods make up a US$9 billion market, and more than 1,500 choices pack store shelves nationwide. Demand for specialized foods, tailored for our furry companions' particular dietary needs, has helped drive this expansion, while the growing number of concerned owners has helped pet supply shops steal customers from supermarkets.

SOURCE: JOHN MAXWELL JR.; WHEAT FIRST BUTCHER SINGER; *ASPCA ANIMAL WATCH*



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Stock Smart developers incorporated live info-feeds from stock exchanges and news organizations into the unique Oracle7™ database schema. Because Oracle WebServer is language-independent, these developers were able to write applications to Oracle WebServer using the PL/SQL language they were most comfortable with. This slashed 75% from their estimated Web site creation time. Of course, Oracle WebServer's native, seamless integration with Oracle® Universal Server® meant superior Web site speed and dynamic content delivery. Oracle WebServer stands alone, yet delivers superior performance with any database.

Weaving the Web

Stock Smart's data needs are massive. Terabyte-sized. So how does all that information get put together so well? Oracle WebServer's Web Request Broker™ works with applications in your favorite language. Its flexible, cartridge-based architecture allows you to create your own application or utilize packaged applications. There are cartridges for Java, PL/SQL, and C++, to name a few. Less code. Less fuss. Out-of-the box construction. What's more, the server can handle countless Web browser requests and ever-changing data to simultaneously deliver customized investor information. This cutting-edge architecture makes bottlenecks a thing of the past, and crashing something that happens only on first-generation Web servers.

Future Smart

www.stock smart.com is attracting so many digital investors that companies are snapping up advertising sponsorships on the site. Future plans include the addition of 15 online financial analysts, and an intranet version of Stock Smart that will be licensed to other companies.

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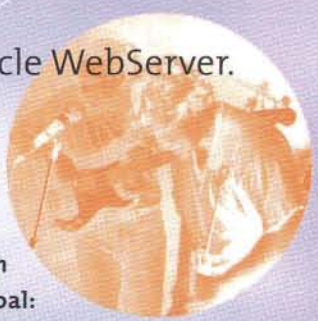
companies around the world to create visionary Web sites.

Virgin Radio takes the multimedia experience to new heights with Oracle WebServer.



Attitude unites the companies of the Virgin empire. The Virgin brand is synonymous with hip products and progressive thinking. Virgin Radio is no exception. Just three years old, Virgin Radio has the ear of 7 million listeners per month, making it the UK's top-rated commercial station. How did they get there? Smart marketing. Creating a Virgin Radio Web site was the obvious next step to accomplish a key business goal: increased global awareness of Virgin Radio.

The Unsinkable Web Server

A hip Web site means never looking like you're working hard. Which means high-performance. Speed, scalability, and stability are key. That's why Virgin Radio turned to Oracle. Oracle WebServer's cutting-edge architecture delivers the highest performance known to the Web. Oracle WebServer's all-knowing Web Request Broker routes browser requests to server extensions running in separate processes. So if one application goes AWOL, your whole system (and your credibility) will remain intact. The Web Request Broker also spawns multiple processes for the same application, which scales the application to speed a motherlode of customer requests.

High-Octane Java

Virgin Radio is an entertainment company. Delivering the richest possible multimedia experience is essential. Virgin Radio was the first radio station Web site in Europe to provide a permanent live radio feed. Virgin Radio chose Oracle WebServer as the hottest multimedia application platform for the hottest multimedia-directed language: Java. Oracle WebServer offers unparalleled Java support, in addition to providing all sorts of Java development tools and plug-ins for added speed and ease. Oracle is the first company in the world to make writing server-side Java applications possible.

The Audience is Listening

The response to www.virginradio.co.uk has been far beyond expectations. International awareness is up. Email pours in from all points on the globe to request songs and enter contests. Plus, the site won the *1996 Yell UK Web Award*, the Oscars of the UK Internet scene, for *Best Use of Technology* and an *Award for Innovation in Broadcasting* from the BT/Radio Academy.

Download a free trial of Oracle WebServer at **http://www.oracle.com/promotions/webserver/**

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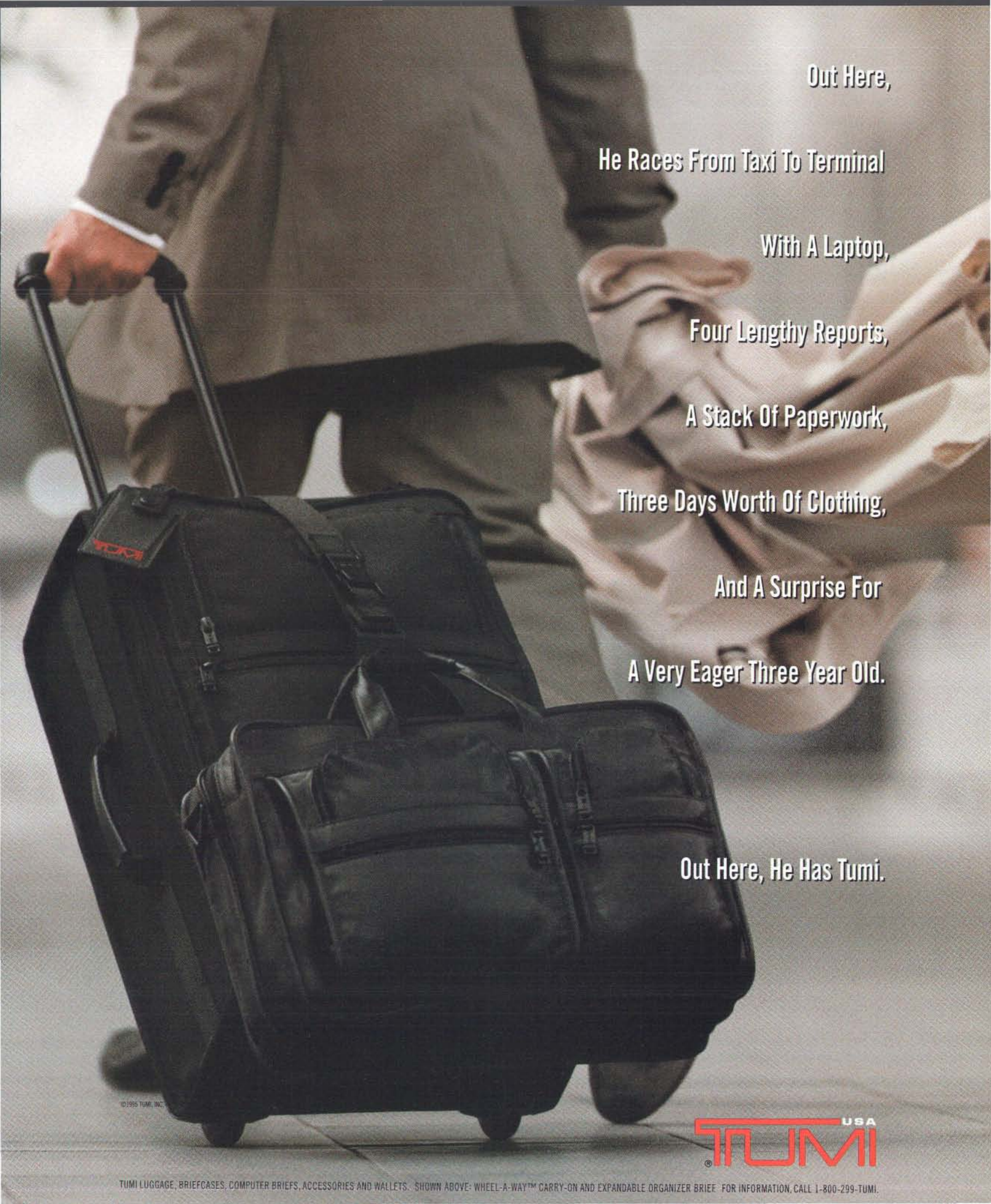
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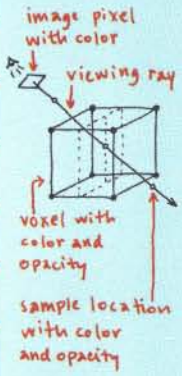
Voxels

Getting beneath the surface.

By Andrew Rozmiarek

One of the main frustrations in modern research is that our ability to collect data is overtaking our ability to present it in an understandable way. In medicine, this has long been a problem, because much of what a doctor knows about what's beneath a patient's skin is gleaned from static X-ray photos, CT scans, or MRI scans. These are often hard to interpret, and it's impossible to see the area from a different angle without putting the patient through another costly, and often uncomfortable, imaging process.



Fortunately, emerging techniques based on voxels – or volume pixels – provide a clearer picture. They allow the physician to view internal tissues as they exist within the body, highlight certain features for maximum contrast, and rotate images to get the best point of view. They create a realistic and reliable 3-D model of structures that have never seen the light of day.

Just as a pixel is a point on a computer screen with a specified color and an *x*, *y* position, a voxel is a point in three-dimensional space with a defined *x*, *y*, *z* position, color, and density. The exact meaning of the density value depends on the type of scan performed. CT scans, for example, measure a tissue's transparency to X-rays, while MRIs gauge the concentration of water. These density values are used to control the opacity of a voxel when it is drawn on the screen.

Streamlining the data

Once an MRI scan or other 3-D data set is represented in terms of voxels, a rendering algorithm must be used to map the results onto a two-dimensional display. This requires many calculations for each point, so the process is sometimes sped up by ignoring voxels that have been made transparent and therefore won't contribute to the final image. To isolate such regions, the data set is divided into what is known as an octree. First, the entire voxel set is divided along the *x*, *y*, and *z* axes to create eight cubic regions. The computer then analyzes each region to determine whether it contains any "interesting" (i.e., non-transparent) voxels. If so, the region is subdivided into eight more. The process continues recursively until none of the octree cubes in question contain interesting voxels, or until they can't be divided any further. The cubes that remain mark the relatively large regions of the data set that can be safely ignored during rendering.

The brute force approach

It's a clever scheme but comes with a significant caveat: You can quickly rotate the image or change the lighting, but if you alter the opacity of any tissue within the scan, the entire octree must be recomputed. This is a slow process on desktop machines and precludes real-time display. On the other hand, if your pockets are much deeper and you can get a machine optimized for image rendering, such as SGI's Onyx/Reality Engine at US$100,000, the octree step isn't necessary. These specialized machines can blindly process every single voxel and still achieve real-time performance.

Marc Levoy, an assistant professor at Stanford University who is well-known for his work in volume rendering, predicts that within five years the average desktop machine will be powerful enough to skip the octree optimization as well.

Putting it onscreen

There are several ways to render volume data, be it as an octree or the entire voxel set. One of the most common methods is known as alpha-blending. In this method, each pixel is defined by projecting an imaginary light ray through the space between voxels in a straight line. Most rendering programs take the average values for color and opacity from the eight voxels closest to the location of the casted light ray. This solves the problem of which data to use when the ray intersects the data set at a point that is not clearly on any single voxel.

This process can be done in a front-to-back or back-to-front fashion. In back-to-front rendering, each voxel occludes the preceding one in proportion to its color and opacity. More opaque voxels will contribute more to the final pixel than the more transparent ones. The algorithm for a front-to-back rendering process is only slightly more complicated but uses the same basic process. The benefit of the front-to-back rendering is that once the maximum opacity for that pixel is reached, the pixel can be drawn even if the entire data set hasn't been traversed.

Alpha-blending produces clear, easy-to-comprehend images. The relative opacities of certain tissues can be manipulated for heightened contrast, and the result looks a lot like the physical sample. There are, however, simpler rendering methods available for specialized diagnostic needs. For example, a common medical procedure is to inject a patient with a contrasting agent – usually a sugar compound containing iodine – that shows up as a bright region in diagnostic imagery. The best rendering process for this type of image consists of displaying only the very brightest voxel along each ray, producing a solid image of the tissues reached by the agent. Another rendering method sometimes used is to simply add all the voxel colors and opacities together like a stack of transparencies, which yields the functional equivalent of a standard X-ray.

The medical profession is making the most extensive use of volume-rendering technology, but other fields have begun to take advantage of the technology as well. Geologists can get a picture of what lies underground without having to extract a single core sample. By analyzing the sound waves produced by a carefully placed explosion, geologists can get a volume whose renderings show a realistic picture of how various mineral and rock deposits are positioned in relation to each other. Engineers can identify imperfections in a machine part before the thing actually breaks. Meteorologists can get a more coherent model of Earth's atmosphere than is possible with a 2-D chart of highs and lows. While volume rendering won't advance our ability to gather data in any of these fields, it will go a long way toward helping us understand what the data means. ■ ■ ■

Andrew Rozmiarek (andy @wired.com) *is a section editor at Wired Online.*

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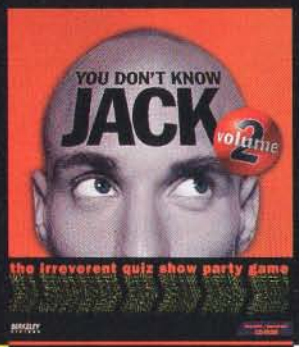
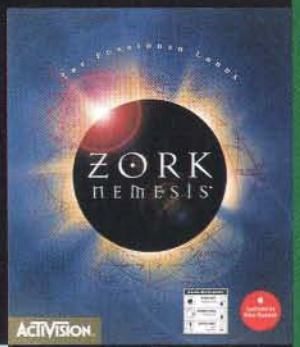
Virtual Pool from MacPlay has all the angles and shots of the real game — and then some. Features 4 great pool games, full-motion-video library, realistic physics and geometry, easy multiplayer modes, realistic 3-D perspective and graphics plus a musical jukebox.

Five hundred years ago, Europe's conquering heroes pursued dreams of a new world. MacPlay's Conquest of the New World is a strategy game where you command explorers, settlers and mercenary soldiers as they discover a new world and build the ultimate nation.

You Don't Know Jack, Volume 2, is the hilarious sequel to the original award-winning game. This Jack comes complete with 800 all-new questions, new question types, celebrity guest appearances, new features and more. From Berkeley Systems.



In Zork Nemesis, you're beckoned to the Forbidden Lands, a cursed world occupied only by the tortured spirits trapped there. Travel through 5 mind-bending worlds to discover the ancient secret of alchemy that will free the trapped souls from evil's grip. From Activision.



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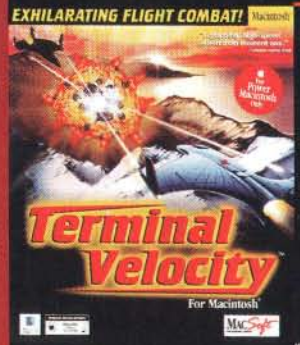
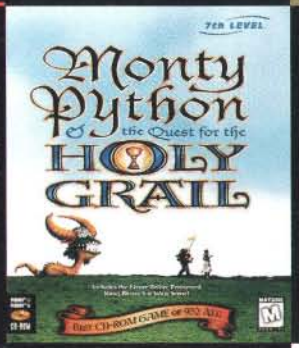


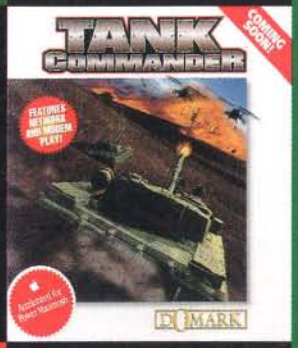
MacSoft's Terminal Velocity offers fast 3-D texture-mapped graphics, full 360-degree flight movement and 7 weapons of extraordinary destruction as you fight your way through 9 unique planets with an awesome array of air-to-air and air-to-ground combat action.



The best CD-ROM game of 932 A.D.— Monty Python and the Quest for the Holy Grail from 7th Level, Inc. It will take you on a romp through King Arthur's England, uncovering clues, solving puzzles and playing wholesome games like "Burn the Witch" and "Spank the Virgin."

Westwood Studios' Command and Conquer takes you into a gritty, high-tech world where the art of electronic intelligence and covert surveillance reigns supreme. Where guerrilla strategies and savage combat are the norm. Muster forces and lacerate your enemies to the bone.

Tank Commander by Eidos Interactive slams you into the cockpit of an M1 Abrams tank as you test your split-second-decision skills against enemy tanks in over 25 fully textured missions. Destroy T-72, Leopard and Challenger tanks with over 7 weapons.



With its incredibly realistic flight models, 3-D photo-realistic landscapes and the use of real-world physics, Flight Unlimited re-creates the most accurate sensation of aerobatic flying ever experienced on the Macintosh. For best results, play before lunch.

Origin Systems' Wing Commander IV is one of the latest space-combat games for the Mac. Take on the role of Colonel Blair, played by Mark Hamill in breathtaking space battles and heart-pounding drama, as you fight your way through the most spectacular Wing Commander yet.

Get ready for the biggest adrenaline rush of the holiday season. We're talking new games for the Macintosh® personal computer. We're also talking sweaty palms. Heart-pounding exhilaration. Stomach-in-the-throat thrills — the works. And here's the best part: with thousands of titles to choose from, you may never come down from that gaming high. Piqued your interest? Good.

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of chestnuts burning? Or just your neurological

receptors going into overdrive?

So now you're probably wondering how to get your twitching fingers on these games. Just visit stores like CompUSA, Micro Center, Fry's Electronics and Staples. Or, flip through any Mac® mail-order catalogs. Or, hop on the Net. But no matter where you go to find them, remember to look for the smiling Mac OS logo. (All great software wears this face.™) If you're ready to take your adrenal glands on the ultimate ride, visit www.macsoftware.apple.com. And learn more about games for your Macintosh and how to find them. Of course, if you want to, you can always use a phone: **call 800-500-4862.**

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The China Index

By Michael Murphy

Half of the world's population has never made a phone call. And a large number of those undialed billions are Chinese. But that will soon change.

I traveled through the Asian giant this fall looking for signs that the biggest developing country would be a reliable producer and consumer of US technology products. I looked for a functioning economy, available power, a low-cost labor force, and, above all, political stability. Will China keep its hands off Hong Kong after the July 1 turnover? Can the nation survive the transfer of power from the ailing Deng Xiaoping without suffering a Soviet Union-like breakdown into ethnic enclaves? To my surprise, I found positive answers to both questions.

The Wired Interactive Technology Fund (TWIT$)

Company	Primary Business	Symbol	Shares	Price Nov 1	Δ Since Oct 1	Action
LSI Logic Corporation	Semiconductors	LSI	7,800	26 ½	+ 3 ¾	hold
Applied Materials Inc.	Semiconductor equip.	AMAT	4,000	26 ⅛	– ⅝	hold
The Walt Disney Company	Entertainment	DIS	1,500	65 ½	+ 3	hold
Apple Computer Company	Hw/sw	AAPL	4,800	24 ¼	– ⅜	hold
Tele-Communications Inc.	Cable television	TCOMA	4,800	13	– 1 ½	hold
Intel Corporation	Microchips	INTC	3,000	108 ¾	+ 13	hold
Adobe Systems Inc.	Software	ADBE	5,000	34 ¼	– 3 ¼	hold
Mattson Technology	Semiconductor equip.	MTSN	30,000	8 ¾	– 2	hold
Euphonix Inc.	Audio sw	EUPH	17,000	4 ⅜	– 1 ⅜	hold
Diamond Multimedia	Multimedia hw	DIMD	7,000	11 ½	– 2 ⅛	hold
Seagate Technology Inc.	Disk drives	SEG	300	65 ⅜	+ 11 ⅜	hold
Portfolio Value	**$1,528,443.75**	**(+ 52.84% overall)**			**– 3.39%**	

Legend: This fund started with US$1 million on December 1, 1994. We are trading on a monthly basis, so profits and losses will be reflected monthly, with profits reinvested in the fund or in new stocks.

TWIT$ is a model established by *Wired*, not an officially traded portfolio. Michael Murphy is a professional money manager who may have a personal interest in stocks listed in TWIT$ or mentioned in this column. *Wired* readers who use this information for investment decisions do so at their own risk.

The Hong Kong applecart

In Tiananmen Square, a clock counts down the days, hours, minutes, and seconds until the government gets Hong Kong back. This would be scary, except that the younger generation seems equally excited about rejoining the mainland. Although the level of corruption in Hong Kong may increase, Beijing is unlikely to upset the economic applecart, because it values a strong economy so highly. China is the sixth-largest holder of US Treasury debt. Its biggest trade surplus is with the US. And China generally represents our largest trade deficit.

The Chinese view Hong Kong as more than an asset to the country's GNP; they see it as an economic model to be replicated in Shanghai. Mark Faber, an investment manager and longtime Hong Kong resident, believes that over the next 50 years, Beijing will build Shanghai into a financial center far more important than the British-owned island rather than take any overt steps against Hong Kong capitalism. The Chinese government also wants to use the experience of Hong Kong to persuade Taiwan to return to the fold sometime in the next century.

Made in China

Given political stability, China will be a great place to produce technology products. Numerous state-owned enterprises are drowning in red ink; an entrepreneur willing to take on the payroll probably can get the building and equipment for free. Factory wages average US$80 a month. Chinese management is not expensive, and many people speak English well. Housing foreign management, on the other hand, is very expensive.

While there still isn't enough electricity, the new Yangtze River hydroelectric dam will provide a major boost all along that industrial waterway. Upriver, through the Three Gorges, the water level will rise 100 feet to 175 feet and drown several towns. People and businesses already are being compensated and relocated to higher ground.

As one of the largest producers of disk drives in China, Seagate Technology is a strong stock pick. Other companies that can benefit from Chinese production include contract assemblers such as SCI Systems and Solectron, disk-drive head suppliers like Read-Rite and Applied Magnetics, and the semiconductor packaging operations of major firms such as Cypress Semiconductor, Integrated Device Technology, and Intel. Although there are no technology mutual funds focused on China, the China Fund is a broad-based, closed-end fund listed on the New York Stock Exchange.

Motorola – 1 billion served

In addition to producing technology, China will play a significant role in consuming it. Acer Computer International and AST Research are the country's main computer manufacturers, and Motorola is a major brand. In the past, the marine telephone service on the Yangtze River cruise cost $1,200 an hour. Now a government-owned cellular phone service is available around major towns for only $24 an hour. Cell phones are everywhere in Shanghai, Beijing, and other major cities.

The success of Western branded goods such as Levi's and McDonald's is good news for leading technology brands such as Compaq, Hewlett-Packard, and others. Without a doubt, the digital revolution is about to reach China: I saw several stores with signs reading "INTERNET" in 2-foot-high letters.

The country desperately wants to be the economic power of Asia. Most Chinese are acutely aware that in 1949, China and Japan were in the same low state of economic development. Chairman Mao took the Chinese down the collectivist path and the Japanese dusted them. The Chinese – 1.2 billion people to Japan's 124 million – feel they should be the powerhouse of Asia. Japan "borrowed" the Chinese written language, religion, and even bonsai. The Japanese invaded the country in the 1930s and bombed the hell out of it. It's economic payback time.

All of this is good news for US technology investors. Acer trades on the Singapore exchange at a low price/earnings multiple. This is the best company for a China play. AST Research, a Nasdaq stock, is losing lots of money in the US retail market because Samsung Electronics, which effectively controls AST, reportedly won't let it exit the retail channel. As soon as that situation is resolved, AST should be a great investment.

China is one more reason to invest heavily in US technology companies that dominate the fastest-growing industries in diverse geographical areas. Because they aren't trapped in the slow-growth US domestic economy, technology companies such as Microsoft, Intel, Adobe, Cirrus Logic, Integrated Device Technology, and Cypress Semiconductor can show good growth for years to come – at least until everyone in China has made their first telephone call.

TWIT$

The portfolio remains fully invested for the predictable technology stock rally into the spring of 1997. ■ ■ ■

Michael Murphy is a money manager who publishes the California Technology Stock Letter *in Half Moon Bay, California.*

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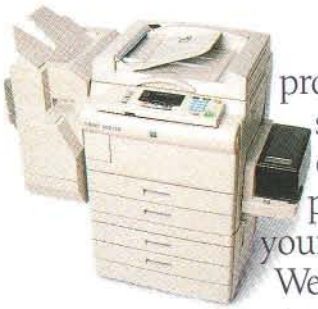

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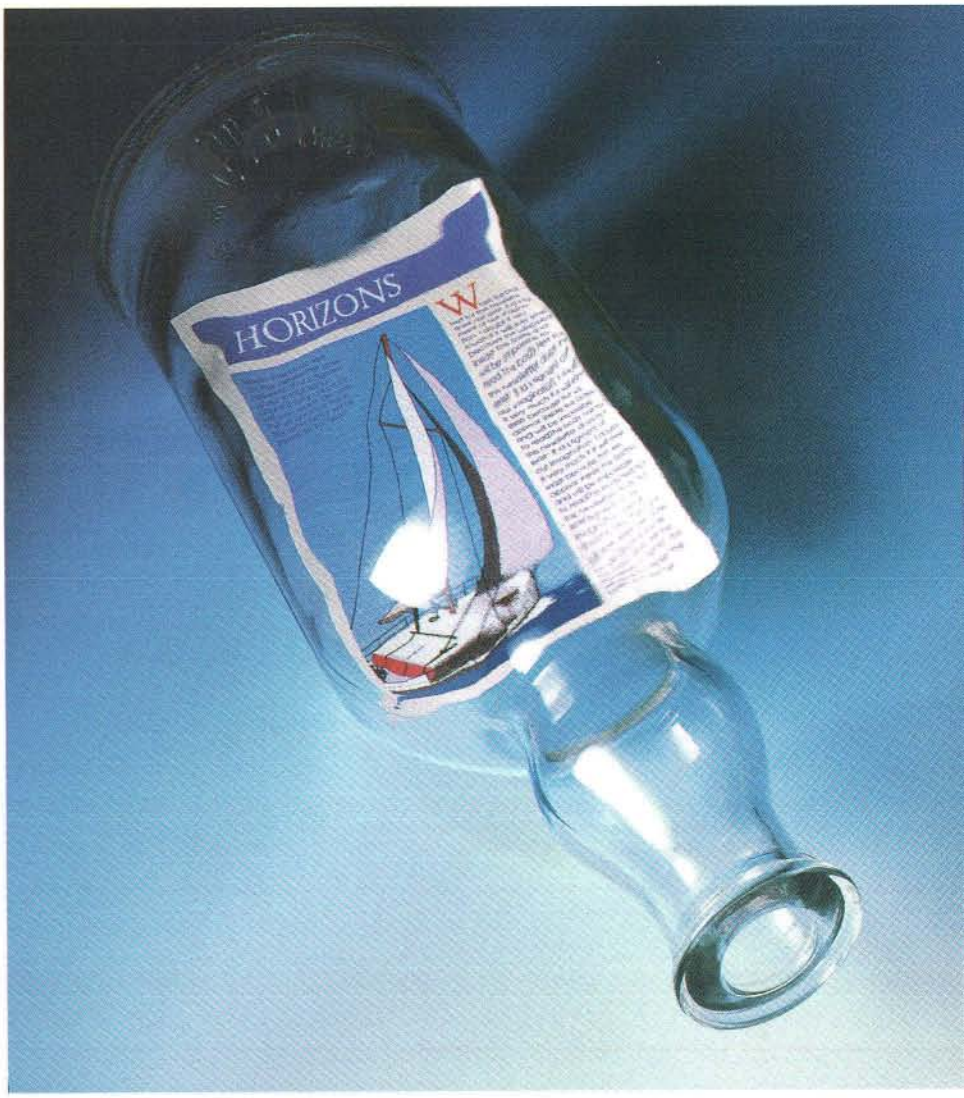

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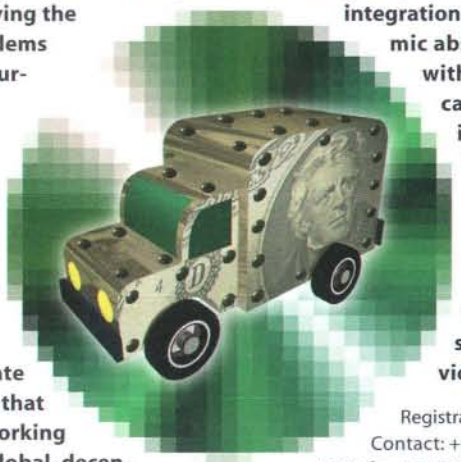
Financial Cryptography 1997.

"I like to joke that digital commerce is financial cryptography," says Bob Hettinga, general chair of Financial Cryptography 1997. "You can't exchange financial information on the Net without link-level cryptography. But financial cryptography is also how you *spend* money on the Net."

Anonymous payments, authentication, copyright protection, micropayments, home banking, fungibility, and digital signatures – these issues are critical to making secure financial networks ubiquitous. At this first-time event, key members from the financial and technical communities will hack the legal, ethical, and technical aspects of networked transactions with an eye toward resolving the security problems that plague current applications of digital cash.

By drawing together technologists and financiers, Hettinga hopes to create a community that will build a working model for a global, decentralized economy. Nanobuck guru Mark Manasse, inventor of Millicent, will attend. So will the man who holds the patent for Citicorp's digital cash infrastructure, Sholom Rosen. Not to mention the contributions to be made by Michael Froomkin, a cypherpunkish civil rights law professor, and offshore banking pioneer Vince Cate. But things will really heat up when netmeister Clifford Neuman meets Federal Reserve Bank bigwig Israel Sendrovic, two impressive minds with wildly different worlds of experience – one a Birkenstocked coder, the other a buttoned-down financier.

It's an unlikely union, but the marriage of finance and computer security holds the key to a future distributed economy. Since the stakes are so high – literally – the integration of algorythmic abstraction with cold hard cash could impact cryptography more than any other issue this side of national security, and vice versa.



Registration: US$1,000. Contact: +31 (20) 592 4169, fax +31 (20) 592 4199, email *ray@cwi.nl*, on the Web at *www.offshore.com.ai/*.

The Current Roundup (see *Wired* 4.12)
January 23-25 The Economics of Digital Information and Intellectual Property; Cambridge, Massachusetts. • **February 5-8** First International Conference on Autonomous Agents; Marina del Rey, California. • **February 10-11** The Internet Society Symposium on Network and Distributed System Security; San Diego, California. **February 8-12** MILIA '97; Cannes, France. • **February 12-15** Interactive Newspapers '97; Houston.

February 24-28 Financial Cryptography 1997; Anguilla, British West Indies See information at left.

March 1-2 Convergence and Diversity: Pacific Asia in the 2020s; Wellington, New Zealand This academic fest unites scholars from around the world and invites them to focus their visions on Pacific Asia a generation from now – in the 2020s. How will local and international forces – like class formation, democratization, gender and minority assertiveness, religious expression, and technology – impact the cultural, economic, and political institutions within this most wired region? Converge on Wellington and discover the diversity of Pacific Asia. Registration: US$90. Contact: +64 (4) 495 5079, fax +64 (4) 496 5413, email *heather.mclean@vuw.ac.nz*, on the Web at *www.vuw.ac.nz/*.

March 1-5 ACM97: The Next 50 Years of Computing; San Jose, California After listening to the technologists at this all-star gathering, you can expect to see clues of tomorrow's technology today. Hobknob with Ethernet inventor Robert Metcalfe, dish with TCP/IP guru Vinton Cerf, jive with Gordon Bell and Brenda Laurel, or hang with Pattie Maes, Carver Mead, and Nathan Myhrvold. You'll probably get smarter just by being there, and if'n you aren't too star-struck to actually learn something, check out the individual workshops on animation, communications, networks, entertainment, education, and medicine. Registration: US$750. Contact: +1 (212) 626 0531, email *acm97info@acm.org*.

March 7-16 SXSW; Austin, Texas South by Southwest is the name of this mega-event, and it's also a signpost to the hippest music festival, coolest indie film scene, and nerdiest multimedia extravaganza – all at the same time, all in Austin, all day and all night. Last year, Iggy Pop rocked while Bruce Sterling spoke and Christine Vachon produced. This year's lineup should top that. Registration: US$800, for entrance to all venues. Contact: +1 (512) 467 7979, fax +1 (512) 451 0754, email *sxsw@sxsw.com*, on the Web at *sxsw.com/sxsw/*.

March 11-14 The Seventh Conference on Computers, Freedom and Privacy; Burlingame, California This digital freedom ride will focus on commerce and community with an emphasis on civil liberties, the social issues created by the rise of digital commerce, and the tensions of free expression on the Net. Building a net.community depends as much on privacy as it does on dialog, and both are worth fighting for. Registration: US$550. Contact: email *cfp97@cfp.org*, on the Web at *www.cfp.org*.

Out on the Range
March 18-22 Technology and Persons with Disabilities; Los Angeles. Contact: +1 (818) 885 2578, email *ltm@csun.edu*. • **March 20-22** Computer Vision, Virtual Reality, and Robotics in Medicine; Grenoble, France. Contact: +33 (76) 56 95 55, email *troccaz@imag.fr*. **April 9-11** The Third International Symposium on Autonomous Decentralized Systems; Berlin. Contact: +49 (30) 25499 309/200, on the Web at *www.fokus.gmd.de/*. • **April 11-13** The International Convention of the Magic Lantern Society; London. Contact: email *s-herbert@easynet.co.uk*.

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Beach Blanket Bartering in Anguilla

The organizers of Financial Cryptography scheduled the conference to end at 12:30 daily, thereby leaving each afternoon for the less cerebral activities offered in the Caribbean. Ringed by 12 miles of white sand and coral beaches, Anguilla is a low-lying island in the British West Indies. If you can't figure out how to have a copacetic time on the beach, you're doomed to a pallid and cloudy existence.

Attracted by the beautiful locale and Anguilla's status as a zero-tax jurisdiction, many Net-based companies – for whom physical geography matters little – flock to the island. Still, wired for *electricity* a mere 20 years ago, Anguilla is now looking to mesh the modern world with its island culture's past.

One interesting offshoot of Anguilla's newfound modernity is the **Anguilla Library Computer Club**, an attempt by the island's wired ones to teach the locals the digital ropes. The club has only six computers: if you would like to add to the collection, send your old computer to Anguilla Computers, Global Links, 4809 Penn Ave., Pittsburgh, PA, 15224 *(nat-trust@offshore.com.ai)*. It'll be appreciated. – *Jesse Freund*

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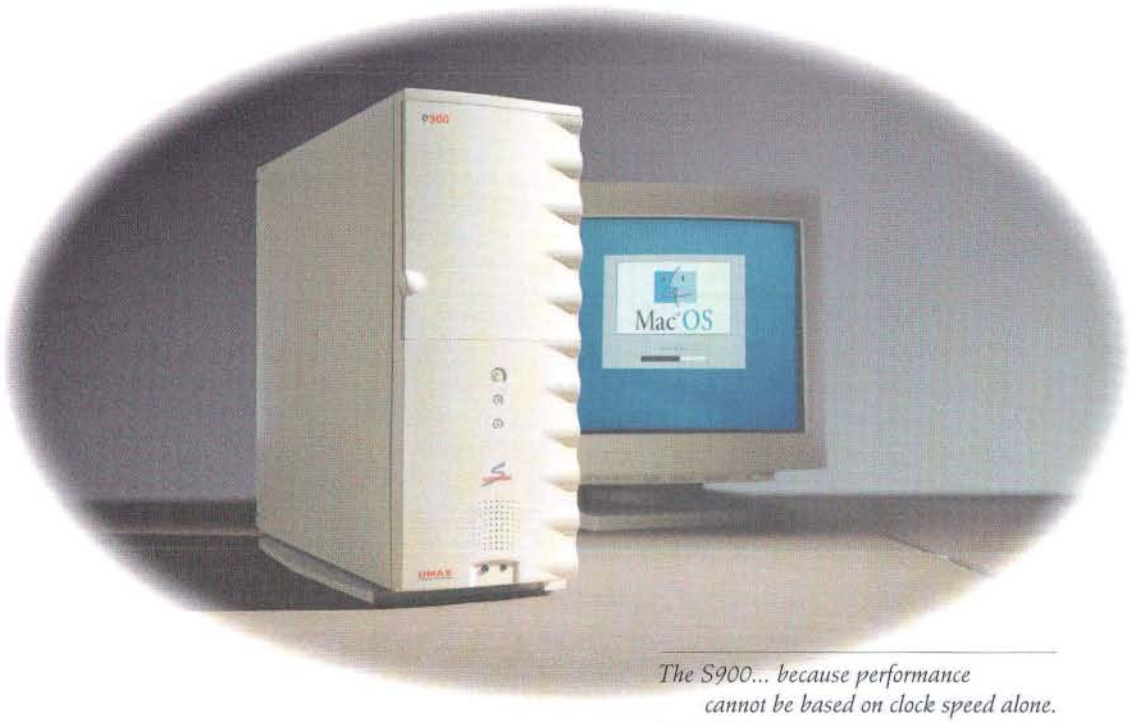

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The Year After Technology

Measured against a human life, 10 years is a long time. Measured against the half-life of a radioactive isotope, it's barely a blink. And so 1996, the year marking the 10th anniversary of the Chernobyl nuclear power plant disaster, was a year of forgetting, and remembering.

Choosing to forget the lethal legacy gripping Chernobyl's surrounding areas, Belarus, the country worst hit by the April 1986 accident, has been encouraging people to move back into the Zone – the evacuated area most contaminated by the disaster. Old people who could not get used to life elsewhere have trickled back home; refugees, drifters, and civilization's outcasts have followed. At first they claimed abandoned houses far from one another, but a new phenomenon – crime – testifies to their lessening isolation. In early 1996, Arkady Nabokin, an 85-year-old farmer aiming for the world record in single-handed cattle farming, was murdered when he attempted to stop youthful thieves from stealing one of his 30 cows.

Yet the scientists remember. One of a handful of local scholars protesting the Zone's reemployment, renowned Belarussian chemist Ivan Nikitchenko calls such moves "irresponsible" and "harebrained." According to Nikitchenko, what was passed off as "deactivation" – the supposed removal of the top layer of contaminated soil – in fact amounted to merely turning over millions of cubic meters of dirt, which sent radioactive dust flying for hundreds of kilometers. In addition, the scientist maintains, contaminated cattle feed and milk products have been distributed throughout Belarus. As a result of these and other actions, the contaminated area has grown consistently over the last 10 years; Nikitchenko estimates it has increased by 68,000 hectares.

Chernobyl's anniversary year offered up a number of other striking disclosures. One study, conducted by doctors at the Gomel Medical Institute, found that children in the contaminated area were less healthy than average in every imaginable way, from their hearts and stomachs to their eyesight. The Institute of Radiation Medicine, home to proponents of repopulating the Zone, argued that most of these illnesses stem from stress and alcohol abuse rather than radiation exposure. To repudiate this claim, Gomel scholars added alcohol to the diet of rats in an ongoing experiment measuring the effects of food containing the maximum amounts of radioactive elements allowed by Belarussian law. Preliminary results show the rodents do better with alcohol, presumably because it inhibits the body's absorption of radiation.

Stationed in Ukraine, US scientists from the University of Georgia have discovered profound genetic mutations in the fish of the area. Animals that received the worst genetic injuries from the accident probably didn't survive to reproduce, yet carp in the region suffer from rearranged DNA and aneuploidy, extra DNA that does not belong in their genetic makeup. Surprisingly, these fish *appear* physically normal.

In the wake of Chernobyl, neither the milk, the fish, nor the children look any different. There are no eight-legged cows or two-headed babies. This helps people forget. Meanwhile, scientists in Ukraine are warning that all is not well at the reactor: the sarcophagus is leaking, and may explode again at any time.
– Masha Gessen

[ORIGINAL STORY IN *WIRED* 4.03, PAGE 136.]

Level Up

In August, Reuters reported that Sega Enterprises of Japan would be banning the use of software that depicts excessively violent and sexually explicit scenes. According to Sega spokesperson Munehiro Umemura, that report was in error.

Though Sega's own ratings system has been in place since 1994, the company has decided to up the ante. As of October, Sega has imposed even stricter ratings and tighter control over games produced for the Saturn system.

No national ratings guidelines currently exist in Japan, and a consortium of top game manufacturers has yet to decide on an industry standard. Instead, Sega has responded to cries from within its own ranks: subcontractors who help produce many Sega games have demanded that the company set itself further apart from the violent and sexually explicit gaming pack.

Sales appear to be holding strong.

[ORIGINAL STORY IN *WIRED* 1.6, PAGE 73.]

Cashing Out

While Visa USA Inc. broke new ground at the Atlanta Games as the first institution to implement a large-scale stateside rollout of smartcards, few would call it a success. Undeterred and claiming the Olympic smartcards were only a test – and could therefore neither succeed nor fail – Visa will undertake its next domestic trial in Manhattan early this year with Chase Manhattan, Citibank, and MasterCard. The reloadable cards may well set the standard for smartcards, which will ultimately supersede any of their magnetic-strip cousins. Visa plans to add credit and debit services as well as tracking capability for merchant-sponsored frequent-shopper programs. Mondex and Europay MasterCard Visa standards are being examined, but the issue of how to provide anonymity is yet unresolved.

[ORIGINAL STORY IN *WIRED* 2.12, PAGE 174.]

C Is for Crypto

Should computer language be protected under the First Amendment? The answer to this question could be the death knell for many cryptographic wars raging across the US – and may well predict the extent to which the Fourth Amendment's guarantee of privacy will be upheld in cyberspace.

As Daniel Bernstein's suit against the US government languishes in court, the young UC Berkeley professor has moved for a preliminary injunction to challenge the International Traffic in Arms Regulations (ITAR) that now threaten to keep him from teaching a cryptography class, due to the "dangers" represented by non-US students.

In a parallel case *(Junger v. Christopher)*, Peter Junger faces a fine as high as US$1 million and imprisonment for 10 years if he chooses to discuss cryptographic software with foreign students in his "Computers and the Law" class at Case Western Reserve University School of Law in Cleveland, Ohio, without prior government permission. Junger sees this as a "paradigmatic example of a violation of the First Amendment." A decision in Junger's case is expected by early January.

[ORIGINAL STORY IN *WIRED* 4.06, PAGE 112.]

IMAGES: BACKGROUND: JEREMY NICHOLL/MATRIX; TOP LEFT: JIM LUDTKE; TOP RIGHT: EUGENE MOSIER; BOTTOM: JORDIN ISIP

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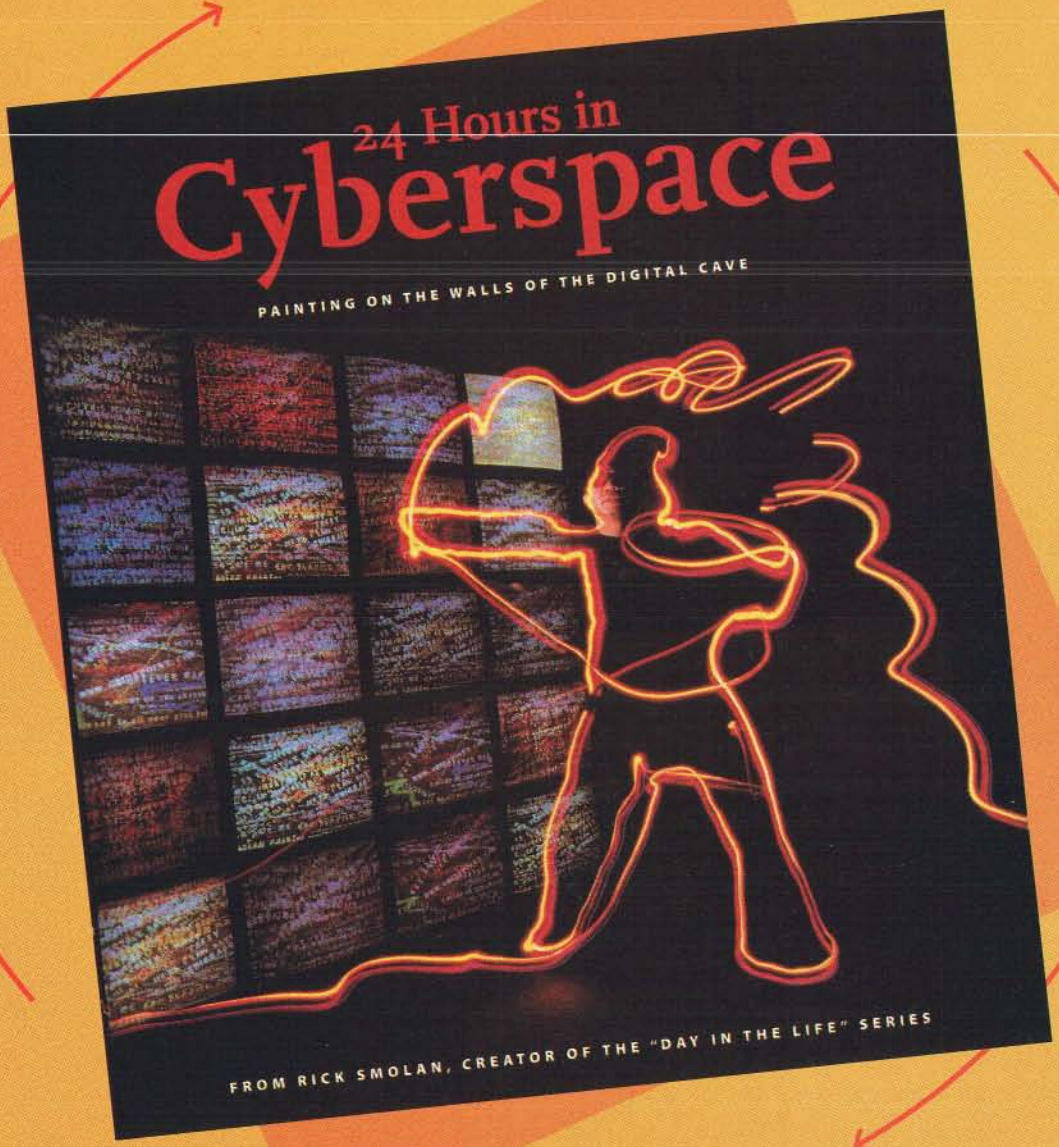

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Technical Foul

The NBA double dribbles on intellectual property.

By Lance Rose

Last year in July, the National Basketball Association scored big in the case of *NBA v. Motorola* when a Manhattan federal court granted the league the exclusive right to transmit scores of basketball games in progress to electronic pagers. All of a sudden, team names paired with numbers – Knicks 35, Celtics 28 – were converted into chunks of intellectual property and handed over to the NBA empire. Immediately after the ruling, the NBA launched another suit against America Online for daring to transmit real-time sports scores to its subscribers. The decision against Motorola is on appeal as we go to press.

This "hot scores" decision signals an alarming new trend in intellectual property rights. The NBA and other sports groups are no longer satisfied with the huge sums they receive from selling TV and radio stations the right to broadcast sporting events. Now they want to control all the information about the games. Before the Motorola ruling, if you invited a bunch of friends over to watch a football game on TV and talk about it over chips and beer, it was called The Great American Pastime. Now, it's become a living room conspiracy to rip off the NFL.

The facts of the NBA case illustrate the absurdity of the decision. The NBA sued Motorola to prevent it from transmitting real-time game scores to users of Motorola's "Sports Trax" electronic pager devices. Only the scores, ball possession, and time remaining were transmitted. Motorola obtained those scores the way most of us do – by watching basketball games on TV. The company then typed the scores into its message system.

The NBA claimed this skimpy data stream represented a large part of the overall value of its pro basketball games. The court agreed, saying, "these products cross the boundary from mere media coverage of NBA games into competing commercial appropriation of these games." With this ruling, the only coverage left for a news organization is to report, "Yes, the game is in progress – and we'll tell you all about it when it's over."

The absurdity grows when we find that even as the NBA and its allies make their bold property grab, they are thoroughly confused about why the court said the NBA should own real-time game scores. According to *The New York Times*, Richard Cotton, general counsel for NBC (which sided with the NBA in this case), argues transmitting real-time sports scores is not "news" but a "virtual re-creation" of the sporting event. Whether or not he's right, such distinctions have nothing to do with the logic of the court's decision.

The Motorola case did not rely on copyright law, but on an old Supreme Court case from the 1920s in which The Associated Press was given the right to prevent competitors from tapping the AP wire service to sell the intercepted "breaking news" stories. So, in an ironic twist, the NBA's new right to prevent companies from reporting sports scores as "news" was borne out of a decision to protect the transmission of news.

Look more closely and the AP analogy will seem even stranger. The defendant in the AP case had intruded on the wire service's transmissions before they were reported by AP's customers – print newspapers. In contrast, Motorola simply copied sports scores from the NBA's customers – TV broadcasters – and did not intrude on any proprietary NBA systems.

How far beyond sports scores does the NBA ruling extend? It's hard to say. Can a news organization simply report "Lakers ahead by 8 in the third quarter" without the NBA's permission? Will the NBA try to censor online chat rooms full of sports fans discussing a basketball game while watching it on TV in their own homes? Can a bartender show a football game on big screen TV to hundreds of customers without paying the NFL for the right to tell those customers the score? What if a famous quarterback suffers a life-threatening injury on the field or a terrorist blows up a bomb in the bleachers? Is that news part of the NFL's property right? What if a famous public official is assassinated on the premises of a privately owned museum, movie theater, or Kmart? Will the owners of these places have a legal right to demand license fees from news organizations that want to immediately broadcast information about the crime?

Our courts are being placed in the role of legislators, pressured by huge media interests to remove "hot scores" and other swaths of information from the public domain. What are concerned citizens to do? If online civil liberties groups hit the courts often and hard with test cases and legal briefs, they may be able to halt the property grab. Judges must be made to understand they are not just ruling narrowly on whether to protect the investments of big corporations, but on whether their decisions will remove broad areas of publicly available data from netizens' hands. ■ ■ ■

Lance Rose (www.netlaw.com/) *practices information and Internet law from Scottsdale, Arizona.*

Nay to Clipper 3.1.1

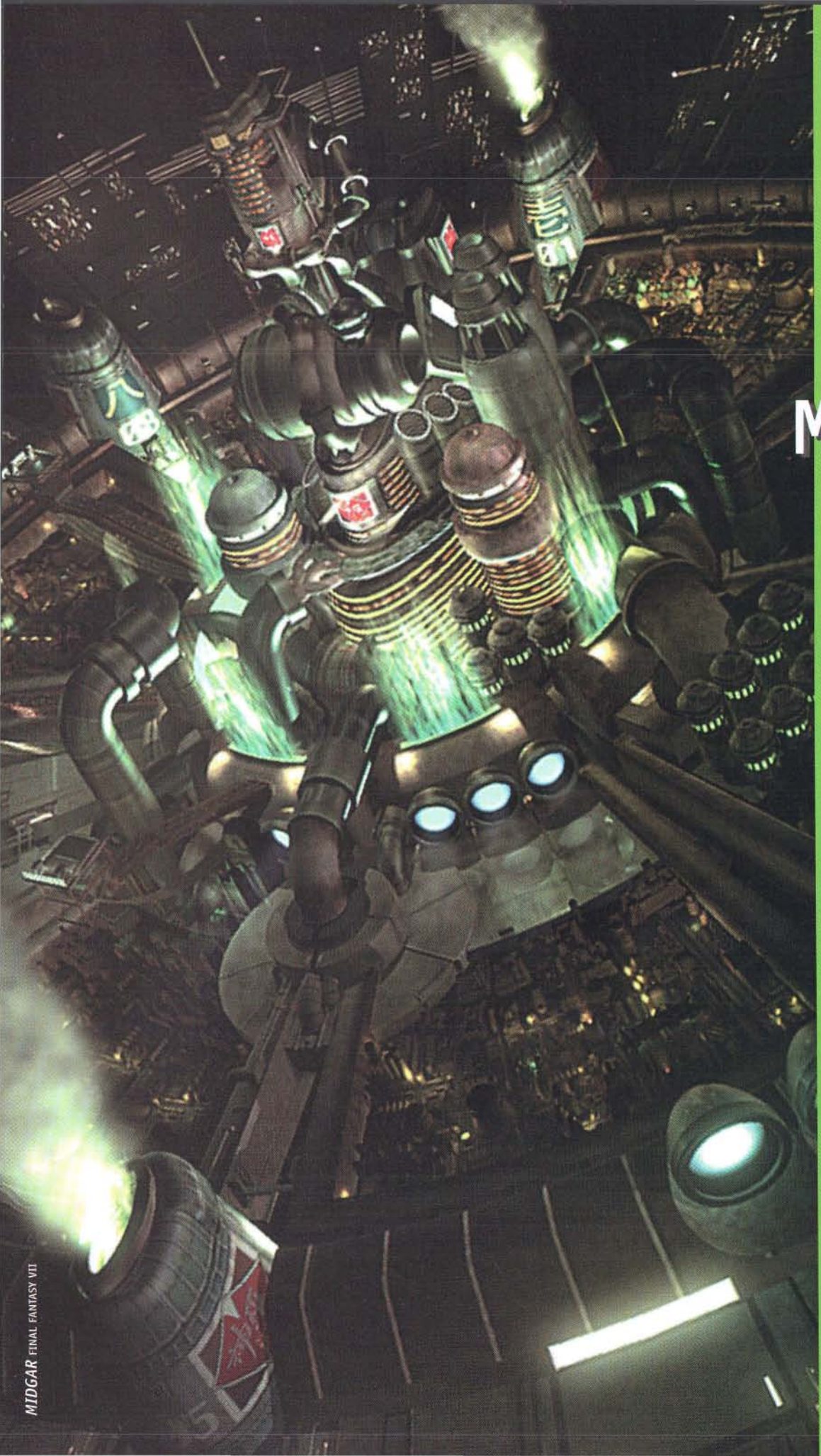
Twenty members of Congress aren't pleased with Clipper 3.1.1, the latest White House proposal to restrict encryption exports and create a key escrow infrastructure. (See "Feds versus Freedom," *Wired* 4.12, page 94.) In a mid-October letter sent to Secretary of Commerce Mickey Kantor, 14 Senators and 6 Representatives complained they "were not consulted in the formulation" of Clipper 3.1.1, which "shortchanges both US business and law enforcement interests." Meanwhile, Senator Conrad Burns (R-Montana) has promised to press ahead with S 1726, the Pro-CODE crypto liberalization bill, during the 105th Congress.

Desperate Despots

Doublespeak, anyone? Burma's military rulers have adopted a new "Computer Science Development Law" that makes it a crime to own or use a fax machine or modem without government authorization, punishable by up to 15 years in jail. Similar penalties can be assessed upon those who use computer networks "for undermining state security, law and order, national unity, national economy, and national culture." Burma's new law has already claimed at least one life. Last June, Norway's honorary consul, James Leander Nichols, died in a Burmese prison after serving six weeks of a three-year sentence for unauthorized use of a fax machine.

Location, Location, Location

The US Supreme Court has declined to hear an appeal filed by Robert and Carleen Thomas of Milpitas, California, who were convicted on obscenity charges in 1994 after a Tennessee postmaster downloaded sexually explicit files from the Thomases' Amateur Action BBS. Observers, including the ACLU, had hoped the Supremes would take the case – if only to clarify jurisdictional issues stemming from the fact that the couple was convicted according to the "community standards" of conservative Tennessee, even though their BBS was based in more liberal California. Having exhausted their avenues of appeal, the Thomases remain in prison.



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The Teacher Who Designs Videogames

Susan Schilling knows the future of education lies on her computer screen, not on a blackboard.

By Paula Parisi

www.wired.com/5.01/schilling/

When George Lucas decided to launch a multimedia education arm of Lucasfilm Ltd., he faced many tough decisions. But selecting someone to preside over Lucas Learning Ltd. wasn't one of them. From the onset there was one woman for the job: Susan Schilling. "I started my search by looking at the products that captivated my own children and found that Schilling produced the majority of them," says Lucas, a self-styled education advocate.

Lucas named Schilling general manager of the division in March 1996. Her move ended a 10-year run at the pioneering educational software firm MECC, where she developed such award-winning titles as Oregon Trail II *and* Mathkeys, *and where she germinated the "learn by discovery" philosophy that would become her guiding principle.*

In her role at Lucas Learning, Schilling seeks to bridge the gap between pedagogy and play: she plans to target products that combine the commercial zing of gamemaker LucasArts Entertainment with the scholastic spirit of the research- and policy-oriented George Lucas Educational Foundation. The first release, a Star Wars*-related product, is expected in early 1998.*

If you make it fun, kids will learn – Susan Schilling knows that good software teaches by drawing children into a subject. "The whole idea of letting kids learn by discovery and exploration is terribly important," she says.

PHOTO: KIM STRINGFELLOW

Wired: What's required of today's educational CD-ROM developers?

Schilling: You need to have people who understand the technology, because they have to translate all of the speeches and the highfalutin theory into something that's practical in that medium. People who think visually, people who think with light – instead of the text-based learning style now prevalent in schools. And you need people who understand kids and what kids are interested in. Over the centuries, most people have been oral and visual learners, rather than text learners. We may be at a point where we're going back to some of those strengths – with the computer we have the ability to make an interactive and active learning experience.

What about the flip side: people are saying that as a society we're getting away from reading and are becoming illiterate.

A balanced life means you can learn in a variety of ways. There are certain people who are predisposed to one way or another. One researcher who's looked into this extensively is Howard Gardner, who wrote *Multiple Intelligences*. Our educational system has picked up on a very analytical, logical, text- and numbers-based way of teaching, which isn't for everybody. The best educational software will include text, visual images, and active participation. A good program is going to give kids as much control as possible over the environment. You need to control the pedagogy.

Having had the catbird seat over the years, what do you think of the state of our public education system?

People who take time to dialog about the education system usually sound like they're damning it. I don't think there are any greater heroes than teachers. But the organization called *school* and the industry called *education* do seem to be in need of reform.

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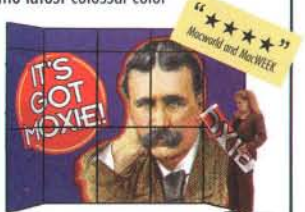

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put them in a classroom, within five minutes they would know exactly what's going on. It's the same blackboard; it's the same book-based learning; it's the same sit at your desk in a row and write down what I'm saying at the board. Any other industry has changed dramatically over 100 years. Education has to go through that transition.

Will technology be an important factor in driving the reform?

I'm not sure. There are certainly indications from the different pilot programs people have tried over the years that technology does have a positive impact on the way kids feel about learning, as well as the outcome. The pilots are good, the evaluations are excellent, but it always seems to stop there. I know that the Apple Classrooms of Tomorrow have produced some incredible documentation around long-term effectiveness of technology use. You could say, 'Of course it's positive – it's funded by a technology company.' But I do believe the results are accurate.

Where do you see specific advantages to teaching in the electronic realm as opposed to teaching with a textbook?

It allows equal access to a high-quality presentation that enhances learning. That learning can be done in the schools, in the homes, in the centers that serve the more disadvantaged populations. One of the most moving experiences I've had was when we did some product testing six or seven years ago with a tool that MECC had developed under a grant from the state of California. It was a geography product, *World Geograph*, and we were testing it with various ethnic groups to see if there were differences in learning styles and how different populations dealt with these tools.

This time we were testing with African-American youth. It was a visual interface, so whatever data you chose would appear on the map. One kid said, "Show me all the countries of the world that have majority populations of people with color," and the whole world lit up. It was an eye-opener for them – as people of color in a white-majority state like Minnesota, they grow up believing that they are not a people of the world. When they saw this picture they went crazy. All of a sudden they were talking about the gross national product of this country versus the state of California. They were learning about geography, they were learning about human history, they were learning about all sorts of things that they wouldn't have been if there wasn't some sort of a personal connection made. A good teacher might have been able to do that, but the fact that they had discovered it themselves made the learning very real and very personal to them.

Having come out of the education market, what's it like rechanneling your expertise to the commercial?

We can leave behind some of the things we'd have to pay attention to if we were targeting schools. Schools have a lot of committees and standards – in certain states, you have to go through many hoops. But now I get to focus on the consumer market, where parents and kids are excited about using technology and just want to get on with it. And that could be the impetus that forces a change – that makes communities and parents say, Wait a minute, this is the future, and my kids aren't getting it in the school. I'm giving it to them in the home, so what am I paying for?

Kids react to technology differently than we do. They know that they can get computers to do what they want, whereas we adults are never quite sure that if we push a button it won't all go away.

How do you envision your unit at Lucas?

We're going to put together three or four teams that we hope will create the highest quality material of both content and presentation. George is providing creative direction for all the products, so he and I are

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meeting about some things he'd like to see happen, specifically, and some of the things he wouldn't like to see happen, specifically.

What would George like to see happen?

A marriage has to happen between solid education and the things kids like to do. It just makes me weep sometimes – there are some good educational experiences for kids, but because of what they see in entertainment, they're not going to choose them. Their parents are going to choose for them, and who knows how long the kids will play with the stuff. There's got to be a way to bring the two elements closer together and let kids experience the magic of learning something. That's not to say learning has to be fun all the time, because we all know that sometimes the stuff we value the most is the stuff we've struggled with.

develop a sense of empowerment over these tools early in life. That's part of why kids react to technology differently than we do. They know that they can get it to do what they want, whereas we adults are never quite sure that if we push a button it won't all go away.

LucasArts has had a lot of success in coming up with the right formula on the gaming side.

Look at what makes games intriguing: they offer challenge, fantasies; they stimulate curiosity; they're internally reinforcing, goal-oriented, complex, and quick. Those qualities can be applied to any genre. You start by finding a task that is educationally meaningful, that provokes thought in the kids. I think the whole idea of letting kids learn by discovery and exploration is terribly

The organization called *school* and the industry called *education* are in need of reform. A century later, it's the same blackboard; it's the same book-based learning; it's the same sit at your desk in a row and write down what I'm saying at the board.

Is it possible to find that happy medium – a product that is fulfilling educationally and also a commercial success?

Yes, but some of what's out there feels like the worst of both worlds.

Care to name any names?

No, but let's just say a product that gives the educational aspect the Missouri River treatment – an inch deep and a mile wide. It doesn't really provide the education, and the entertainment value is compromised as well because the designers think they're doing something solemn and serious. We need to look at what makes games fun and see how to apply it to meaningful content delivered in a purposeful way. It comes down to active learning, as opposed to interactive, which is what you have in the games environment. Active learning starts with giving children creativity tools. The opportunity to use a drawing program or a painting program to create allows them to

important. So, what we're looking at is an environment that's fun for kids, with characters they recognize and have some kind of positive thoughts about.

Will you be leveraging characters from the Lucasfilm library?

Conditions being what they are, I don't think you could enter the consumer market today without having a strong property behind you, and George has certainly got some of the strongest. Right now, we're looking at the *Star Wars* universe and choosing the things that make the most sense to deliver an educational message. Eventually, we'll be looking at the *Indiana Jones* material. It's so rich. It's just waiting for someone to do something with it, and Mr. Lucas would just as soon do it himself as let someone else do it.

Are there any excellent edutainment titles out there?

I think so. Obviously, there are the enduring ones, the ones they call "evergreen" products. They're evergreen for a reason. Some of them might have been the first in a category and have been updated as the technologies have grown. The new versions haven't violated anything critical to the original idea, so it kind of kept growing. You've got all the *Sim* products – *SimAnt, SimCity*. Then you have other evergreens like *Where in the World Is Carmen San Diego?* and *Oregon Trail*. *Oregon Trail* is a simulation, and *Carmen San Diego* is an adventure and problem-solving thing, which really is a new category.

What other categories are there ? What will you focus on?

You've got creativity tools; you've got simulations; you've got storybooks. Then there's drill and practice, which a lot of parents are comfortable with because it reminds them of how they learned. A *Math Blaster* or a *Reader Rabbit* is appealing to parents, and they're the ones who buy them for kids: "I know this, this is drills!" But parents have to understand why they're buying the software. Do they want it to babysit the kids? Or do they want to be at the computer with the kids, creating something? Then there are parents who are looking for academic subject matter to enhance something the child already has, and that's another category.

We'll take an interdisciplinary approach, using combinations. I think it's fair to say we won't be doing anything that's pure drill.

Do you think CD-ROM is its own creative medium rather than an offshoot of games or movies?

I can see it both ways. It could just be a temporary technology while we all wait for things to happen interactively on the Internet. Alternatively, it does have some characteristics that make it a unique environment, because of the ability not only to present visual images and moving images, but also to interact with them. In the Hollywood realm there was a lot of porting stuff over, and in the educational realm there was a lot of just, Well, let's run this off to a CD and say we've got a CD product. As you get into designing for the CD you find that it has different capabilities and features. So we'll have to see how permanent that medium is.

Will online classrooms ever be a reality?
A good application of an Internet program can really bring the learning alive. One product, called *Project North*, is a good example of that. It tracks the arrival of spring on the North American continent. The kids track it from their homes. They do backyard research and start reporting to each other when the first leaf came out on a certain tree, when they saw the first monarch butterfly, and when the first robin appeared. Then the teachers start to build maps and follow the migration patterns – all based on kids' input. Then they have discussions in the classroom. Why do you suppose insects come before the birds? And why do you suppose this particular species takes this route rather than going farther west?

Again, a good teacher who knows how to use the tool can really make it something that the kids own. And if you own your learning, it becomes a lot more important to you than if it's something that somebody makes you do.

There are many ways the technology can help the educational aspect, the content and the instruction. But part of what we're teaching our kids is to be in a relationship with others. Technology can't help with all of those social and physical skills you're developing in the classroom.

If you own your learning, it becomes a lot more important to you than if it's something that somebody makes you do.

How would you define the purpose of schooling today?
A lot of the charter schools see their purpose as training kids to be worldwide citizens. When my son graduates from high school in 2000, his competition for a job is not going to be here in California, it's going to be worldwide, with the kid from Japan, the kid from Switzerland. The forward-looking people are getting a very different picture than those who look backward to the industrial model and at what kids needed to be productive citizens then.

I could wax eloquent, and I know George could also, about saving the democracy (laughs). But it kind of comes down to that in a lot of ways. If we're not educating kids to value democracy, to value freedom, and to be able to work in a global way to solve global problems – because we're all connected – then there's not much hope for the republic. ■ ■ ■

Paula Parisi (73404.720@compuserve.com) *is an editor at* The Hollywood Reporter.

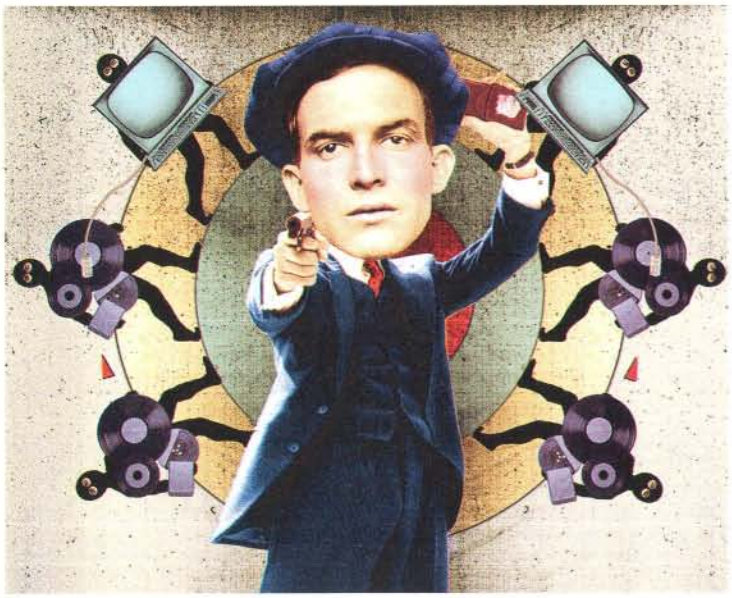
Talk with Susan Schilling live Thursday, January 16 at 1 p.m. PST at *www.wired.com/5.01/schilling/*.

Digital Underground

New technologies that make it possible to send high-quality sound clips over the Net have created a crafty distribution highway for music pirates. And the multi-billion-dollar recording industry is scrambling to catch up.

By Don Steinberg

www.wired.com/5.01/bootleg/



Future tense: bootleggers have ably demonstrated that it's easy to eradicate the need for a go-between (read: record label) when shuttling a song from performer to fan.

Early one Tuesday morning in July 1996, Dorothy Sherman was doing what her rock-star clients hire her to do: getting the goods on music bootleggers. Sherman is founder and president of GrayZone, a Brooklyn-based research firm that works with performers, record labels, a tangle of government agencies, and industry groups such as the Recording Industry Association of America (RIAA) to ferret out those digital desperadoes who electronically distribute unauthorized musical performances.

Sherman was going about her business – examining messages on alt.music.bootlegs, ordering illegal CDs from Web pages – when the phone rang. It was a law enforcement agent.

"It's happening today," he said. "In about an hour."

"It?" she asked.

"The *big* it," the agent replied.

Across the Brooklyn Bridge, federal and state investigators were taking down two Greenwich Village institutions. With badges flashing, plainclothes detectives strode into Second Coming Records on Sullivan Street. The store was widely known to carry bootleg discs (often sneakily labeled as "rare imports"), but nobody made such a fuss before. Now, some seriously armed officers were combing the place, grabbing every Pearl Jam, Hootie, and Hendrix disc that looked suspicious. They told the stunned salesdudes that they were being busted under a newly amended state law that criminalizes distribution of bootlegged music recordings. Moments before, agents grabbed Second Coming's owner near his warehouse in Queens, seizing 70,000 unauthorized CDs that were feeding the store and a thriving mail-order business.

A few blocks away, at Revolver Records on 8th Street, uniformed cops and FBI agents broke down the door. Word had already hit the street about the Second Coming raid, and Revolver's staff, correctly assuming they'd be hit next, had locked the entrance, tried hastily to hide offending inventory in a storage room, and fled out a back door.

In a triumphant postbust press conference, New York Attorney General Dennis Vacco stood at the entrance of Second Coming Records and crowed. The busts netted 17,000 CDs and capped the biggest week of bootleg disc seizures in history. Days earlier, US Customs agents had stormed a Long Island warehouse to confiscate 425,000 imported discs and 2.3 million label inserts (the artwork that slides into CD jewelboxes). Vacco declared lower Manhattan safe from unauthorized concert recordings.

Not entirely. On the day of the bootleg busts, if you'd been planning to swing by Second Coming to pick up, say, *Perfect Timing* – a CD of an illicitly taped 1995 Alanis Morissette show in Los Angeles – and you'd been put off by the phalanx of patrol cars around the store, you simply could have walked a few extra blocks to one of the Village's cybercafés. Sipping a latte, you could have pointed your browser to the Web page of an online bootleg shop called Magic Com, select *Perfect Timing* from an elaborate catalog featuring hun-

IMAGE: FRANCISCO CACERES

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○ Hooded with pocket	○ L ○ XL	$30 x		
○ Crew neck	○ L ○ XL	$25 x		
Polo Shirt				
○ Short	○ L ○ XL	$30 x		
○ Long	○ L ○ XL	$35 x		
Logo T-shirt				
○ Short	○ M ○ L ○ XL	$17 x		
○ Long	○ L ○ XL	$22 x		
Wired Messenger Bag				
○ 14"x 8"x 11"		$65 x		
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A PUBLIC APOLOGY

FROM THE LOTUS DEVELOPMENT CORPORATION.

We recently began running a commercial in which Web surfers are excoriated by Denis Leary for using the most significant innovation in human communication since smoke for trivial purposes.

Subsequently, we have received an avalanche of outraged e-mail from Web surfers who feel that viola jokes and real-time snapshots of fish tanks are anything but trivial.

Lotus Development Corporation would like to make clear that we have nothing against these uses of the World Wide Web. Many of our own employees are interested in wrestling trivia, crop circles and recipes for zucchini bread.

We were merely seeking an interruptive way to announce that the Web is now ready for business, thanks to Domino, an Internet software product that brings the power, security and functionality of Lotus Notes to any Web browser.

It's a revolution that will change the way business works, and we felt it was worth making some noise about. Especially since it's available now and it works, unlike certain vaporware 'net products being promoted by our competitors.

So we apologize to all those who use the Web for fun. To make amends to this audience, we are planning a $7 million commercial with a '70s rock song featuring a politically correct group of children using the Web to share their frog dissection experiments with the world. If we can find the budget.

We suggest that others who may share our crass interest in cutting costs and increasing profits visit our Website at www.lotus.com.

Thank you.

Lotus

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dreds of artists, place the bootleg into a whimsically illustrated shopping cart, and order it for home delivery for a cool US$21 plus postage. Visa and MasterCard accepted. And no laws would have been broken.

Isn't it ironic? Don't you think?

But this is far more than an elaborate legal cat-and-mouse game. Thanks to rapid developments in online audio technology, the efficient digitization and distribution of unauthorized music threatens to radically reorder an infrastructure that major labels have spent decades creating. Bootleggers have demonstrated that it's easy to eradicate the need for a go-between (read: record label) when shuttling a song from performer to fan. Illicit electronic music files are few and far between now, but their very existence portends huge ramifications. Unwittingly, bootleggers are forcing the music industry to tangle with a future that the bigwigs are still unprepared to embrace.

Rationalizations defending bootlegs are served up daily on alt.music.bootlegs:

"Rock stars are so rich that fans deserve to get some stuff free";

"We're only capturing some magic that would be lost";

"Copyright is a doomed concept anyway, so who cares?"

The Internet jukebox

The RIAA says the American recording industry loses approximately $300 million a year in "displaced sales" from unauthorized recordings. First, let's clarify some terminology (which record companies sometimes prefer to blur). A *bootleg* is a recording of a concert or unreleased studio session – something consumers aren't supposed to be able to buy. Prince's so-called Black Album, for instance, was bootlegged in about 75 different versions in the five years between its still-unexplained liberation from the recording studio and its official release by Atlantic Records.

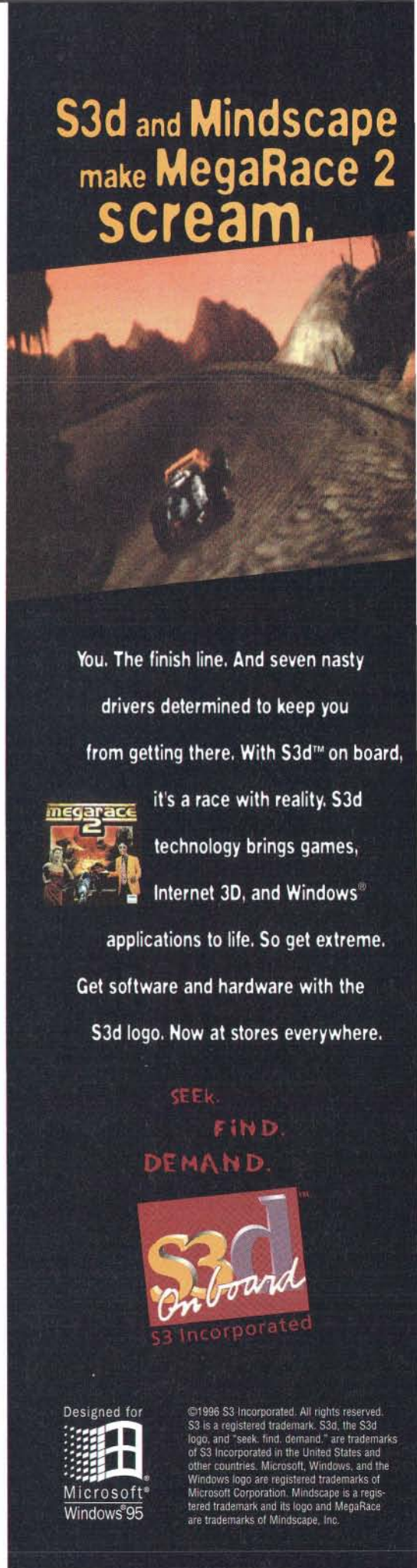
Counterfeits, by contrast, are whole-hog duplicates of released albums, while *pirate* recordings are hybrids that combine, say, concert material, B-sides, and studio outtakes with whatever else is lying around.

The dollar damage attributed to bootlegs is high but somewhat misleading. The RIAA multiplies the discs and label-inserts seized by the street price of a bootleg disc ($20 to $40). It adds up fast, but in fact the RIAA's "displaced-sales" figures are actually an extrapolation based primarily on seizures of counterfeit cassettes.

Some argue that bootlegs don't displace the sale of legitimate records, because they're primarily obtained by diehard fans who have already bought all the legal stuff. Further rationalizations defending bootlegs are served up fresh daily on alt.music.bootlegs, including: "Rock stars are so rich, fans deserve to get some of their stuff for free"; "We're only capturing a little magic that would have been lost otherwise"; and "Copyright is a doomed concept anyway, so who cares?"

But many musicians complain that any unauthorized release usurps their artistic control. Bootlegs constitute illegal use of someone else's creative work, and for organizations such as the RIAA and ASCAP that exist to protect usage rights, they glow large on the radar screen.

In the past, curtailing bootlegged CDs and albums was pretty straightforward: bust the manufacturing plants or distribution points (i.e., stores like Second Coming and Revolver). But the many-to-many design of the Internet quickly destroys this traditional method of enforcement. And it offers a clue as to why music copyright holders fear the Net, a place where they see a horrifying collusion of the information-wants-to-be-free attitude with rapidly improving audio transmission technologies.



Until recently, the biggest drawbacks to downloading music from the Internet were time and quality. With a 14.4 modem, for instance, it can take four minutes to download one minute of a tune in FM radio-quality mono. For stereo-CD quality, that same clip could take an hour. Suddenly, the prospect of waiting and waiting and waiting for a scratchy audio clip from an old Nirvana show makes the novelty a good deal less charming than it first seemed.

But those problems are disappearing. Since last summer, breakthroughs in the Net's ability to carry high-quality streaming audio have come fast. Macromedia Internet Products Manager Joseph Ansanelli promised to "turn the Internet into a jukebox" when the company added CD-quality streaming audio to its popular Shockwave plug-in for Web browsers (although you still get only "mono FM quality" at 28.8 Kbps). And Shockwave doesn't require a dedicated server, so anyone can cheaply put high-quality audio on any Web page.

Progressive Networks came out with a stereo upgrade of its RealAudio Player, as well as RealAudio Player Plus, which lets originators of RealAudio 2.0 transmit sound without recording-prevention. This feature is meant to let music owners sell discs online, but it also provides a mechanism for a bootlegger or a pirate to distribute unlicensed material on demand. In October, 40 companies (including Progressive Networks, Macromedia, and Netscape) announced support for Real Time Streaming Protocol, a proposed standard for instantly slinging audio and video over the Internet.

Liquid Audio, a new company formed by music industry veterans, has just delivered software that may provide the highest quality online audio of all. Using Dolby-based compression, Liquid Audio's software delivers near-CD quality streaming music at 28.8 Kbps. It can transfer a full, CD-quality (44-MHz, 16-bit stereo) file of a three-minute song, over a 28.8 connection, in about 12 minutes. With the faster link of a cable modem, the same song file could move "faster than real time" – perhaps in one minute, says Liquid Audio's Robert Flynn.

The next step is to connect your computer to a recordable CD – and voila! – you've got yourself a new disc. And the major labels haven't pocketed a penny. Not coincidentally, Liquid Audio is about to release software called Master ProPlayer, for improving the sound quality of recordable CDs at home.

Clinton Heylin, author of *Bootleg: The Secret History of the Other Recording Industry* says the bootleg community "has always embraced new technologies that the music industry feared," from CDs to digital audio tape – which due to its luxury price has come to be used almost exclusively for material you can't buy on a legitimate CD.

AudioNet started an online "CD Jukebox," which allowed anyone to hear sound samples from hundreds of albums. It figured that most record companies would be glad for the exposure. Wrong.

Record company executives rarely see the enormous potential for selling their product by wire. Instead, they panic. Albhy Galuten, VP of interactive programming for MCA Music Entertainment, is one of the few insiders who sees the positive potential but understands the concerns. "Someone could make a file of a complete CD and send it to 25 of their closest friends," Galuten recently told *Billboard*. "The potential impact on the music industry is very scary."

But only to the timid. Early last year, AudioNet, the largest provider of audio content on the Internet, started a "CD Jukebox," which allowed anyone with an Internet connection, RealAudio Player software, and a soundcard to listen to sound samples from hundreds of albums. AudioNet president Mark Cuban hadn't asked most of the record companies for permission. He figured they'd like the exposure. And since his service wasn't charging people to listen, and the streaming audio didn't let people keep copies of the music they heard, it was exactly like a radio station. Wrong.

Sony Music and the RIAA reminded him of the Digital Performance Right in Sound Recordings Act, which went into effect in February 1996 after intense lobbying by the RIAA. The law established interactive, digital delivery of music as a different beast from analog broadcasts. Owners of sound recordings (i.e., the record labels) now have exclusive say over how their music is used online. That's a right they don't have on, say, radio, where stations can play whatever they please without the label's permission (radio stations do need licenses from songwriters' organizations such as ASCAP and BMI – as do sites that play music online).

The RIAA claims the on-demand interactivity of online music makes the law a necessity. Cuban says it's unjustified. "Say you're planning your bar mitzvah, and the DJ wants to preview some of the music over the Internet for your grandparents," he says. "One's in Miami and the other's in Chicago. So, what? You go to jail?"

Old laws, new technologies

As in all earthly matters, the first line of defense is law – and belligerent lawyers. Internationally, agreements such as the Berne Convention have forced signatory nations to incorporate universal principles protecting intellectual property into their national laws. In April 1996, for instance, students in the Nettverksgruppa computer society at the Norwegian University of Science and Technology loaded several hundred rock albums onto a university server and made them downloadable for free through the Net. The catalog literally went from ABBA to Zappa. The hammer came down quickly. Since Norway supports interna-

tional trade agreements, the International Federation of the Phonographic Industry, a global alliance of 1,200 record companies promoting copyright protection, was able to make the kids reconsider their decision.

President Clinton's 1994 signing of the General Agreement on Trade and Tariffs has also helped put the pinch on purveyors of unauthorized music. GATT required its participants to punch up antibootleg laws. So now we have the first federal antibootleg statute to supplement state laws. When, in August 1996, a public area of America Online was promoting bootleg tape trading, horrified record industry officials shut it down by waving a copy of GATT. Tape Traders' Central, a section of ABC's Rock and Road site within AOL, brazenly listed must-have bootlegs, hosted message boards where fans arranged trades and sales, and even offered special downloadable artwork to slip into bootleg cassette cases. The main sponsor of the site was Maxell, the blank cassette manufacturer. "It was unbelievable," says Richard Gusler, attorney for Hootie and the Blowfish.

The response from AOL and ABC? Whoops! The site was nuked within hours of the music industry's complaints.

Such tape trading sites are distressingly common. So some of the biggest names in music turn to Sherman, who provides research on bootlegging activity for the likes of Prince, Lou Reed, and Hootie and the Blowfish. She and her small band of "cyberpunk operatives" in London, Paris, New York, and San Francisco are plugged into a "tape traders' network" where fans exchange concert tapes, post critiques and want-lists (i.e., "WANTED: Pumpkins, 2/10/96 at the Moore"), or seek recommendations from kindred souls about microphones, digital audio tape recorders, and illicit soundboard-patching techniques.

But tape traders are small potatoes. The long-term threat remains the instant (and surreptitious) gratification provided by streaming-audio technology. And while the lawyers try to punch up existing laws, the recording industry works on antipiracy technology. Early in 1996, the RIAA formed a New Technology Division and hired David Stebbings to run it. Stebbings is described as "one of the industry's top scientists" who previously worked at Sony on copyright protection for the Digital Versatile Disc (not coincidentally, a technology that's been long delayed by content-owners' piracy issues).

An AOL site brazenly listed must-have bootlegs by artists, hosted message boards where fans arranged trades and sales, and even had downloadable artwork. AOL's response? Whoops!

One of Stebbing's top missions is to "develop monitoring systems for finding unauthorized sound recordings on the Internet and formulate high-speed searches." The idea is to take data that's already written into a subchannel of all audio CDs – information about the music, who owns it, where it originated – and embed it in the audio in a way that doesn't audibly interfere with the music (sort of like the subliminal suicide messages in Judas Priest tracks). This "digital watermark" would be inseparable from the music, capable even of "surviving all analog links," Stebbings says.

The RIAA would then set up powerful search engines to continually scan files for the encoded information. This would let the industry "monitor a certain small percentage of what was going on the Net and say 'Ah-ha' every time we came across one of our recordings," Stebbings says.

He admits that this scheme, at best, will track where a portion of copyrighted music is moving, not stop the sale of illegal recordings or the transmission of concert recordings. Says Stebbings, "I don't know of any

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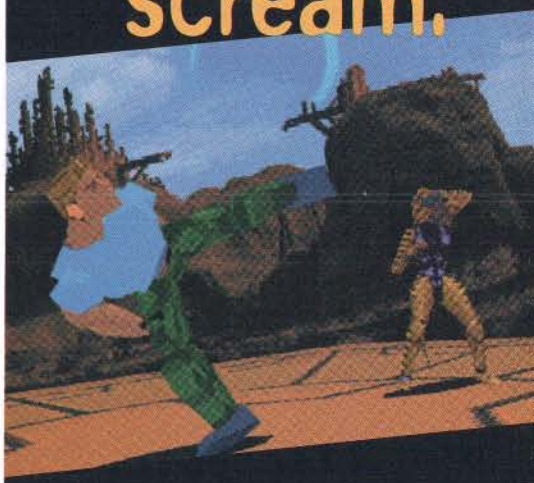

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technical way of actually stopping the stuff from getting on the Web in the first place."

The industry's concerns have pressured some streaming-audio companies to build digital watermarking into their software. But these sometimes seem, well, watered down. While listening to a RealAudio clip of the Beatles in the studio recording "All You Need Is Love" from a fan's well-stocked Web page of rare Beatles recordings, I noticed that RealAudio Player software indeed has a copyright field that appears while the music plays. But for this clip, the fan who digitized it had entered "1967."

Liquid Audio has built an elaborate system for selling music via the Net that encapsulates a recording's copyright data with the audio (plus lyrics, cover art, and liner notes) in a single master file. The software also lets the music's originator be all but certain that the receivers can make only as many copies of the recording as they pay for. Again, there's a hitch: it doesn't prevent a bootlegger in Luxembourg from using the software to sell files of taped concerts, which have no copyright.

Already, N2K and Liquid Audio say they have been approached by recording artists who are contemplating skipping the major labels entirely in the future and releasing their music online.

In a sense, music could become the first major packaged product to make the fabled transition from atoms to bits. That's a scary concept to those with a heavy investment in atom-based commerce.

Indeed, one might suspect that recording industry officials took some gratification from the fact that the pair of Greenwich Village busts punished stores that not only sold tons of bootleg recordings but also happened to be two of the city's leading sellers of used CDs and tapes. That's a completely legal practice that robs record companies of sales.

One might similarly suspect that the industry's hand-wringing about putting

Maybe it makes sense to turn the recording industry's fervent antipiracy effort on its head. Perhaps companies feel as threatened by the legal prospect of online music as by the scattershot illegal activity.

If all this watermarking and search-bot stuff sounds overambitious – and possibly somewhat desperate – maybe it makes sense to turn the recording industry's fervent antipiracy effort on its head. Perhaps it feels as threatened by the completely legal prospect of online music as by the scattershot illegal activity.

"I don't think digital copying is really the major issue here," asserts Larry Rosen, whose N2K Entertainment has created the online music sites Music Boulevard, Rocktropolis, and Jazz Central Station. Rosen implies that the stink over copyright problems may be partly a stalling tactic as established companies contemplate how to deal with the new technology – and the fundamental shift it may bring to the way they do business. "They're trying to protect the status quo," Rosen says.

music online represents a way to, in the absence of being able to outsmart the future, at least delay it.

"But they're also smart enough to know that they can't just stand in the way of this," says Liquid Audio's Flynn. "Because it's gonna happen, with or without them." ■ ■ ■

Don Steinberg (dons@cynet.net) *writes the technology column for* GQ *and edits the humor zine* Meanwhile *on America Online.*

Talk with author Don Steinberg live on Monday, January 6, at 1 p.m. PST at *www.wired.com/5.01/bootleg/.*

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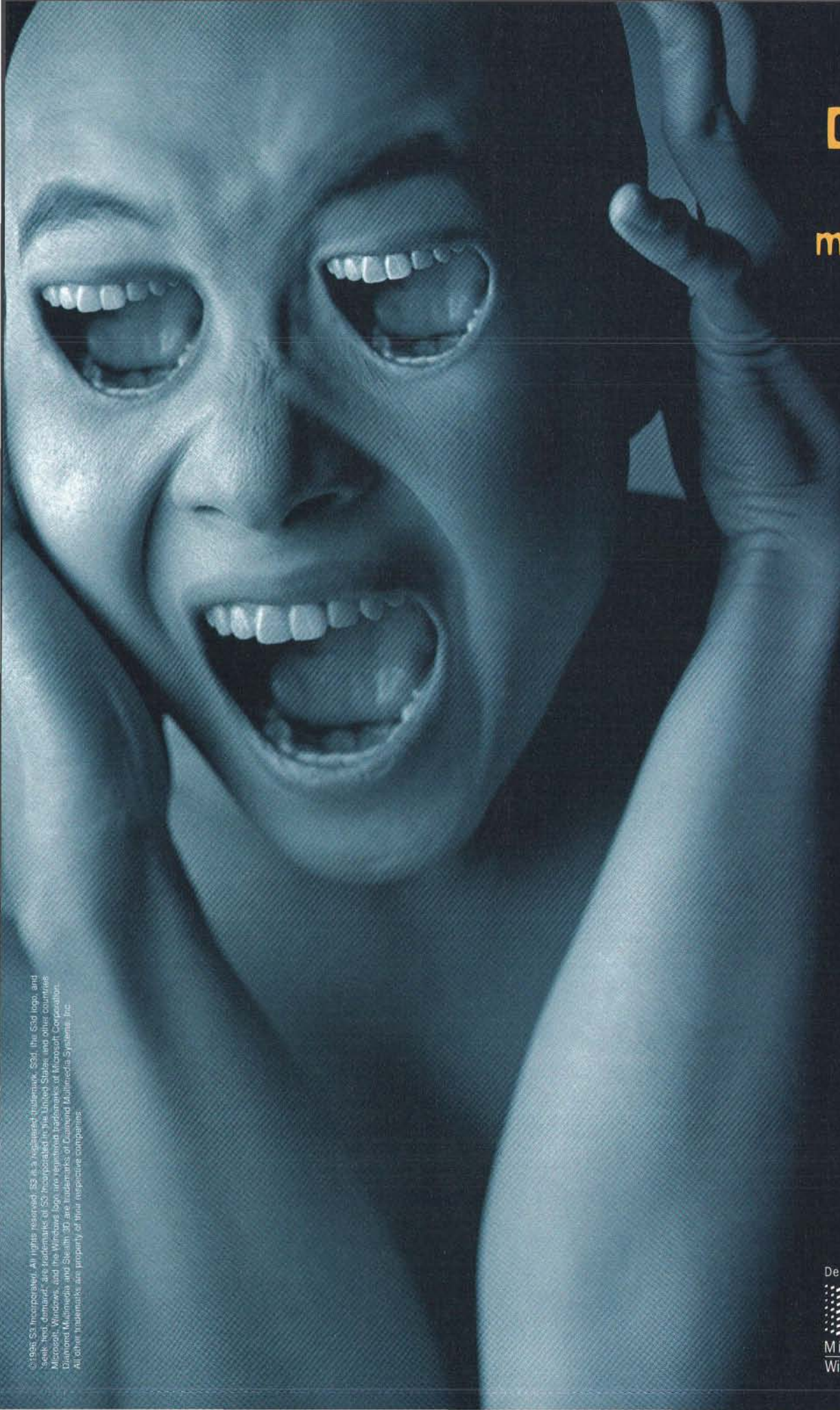

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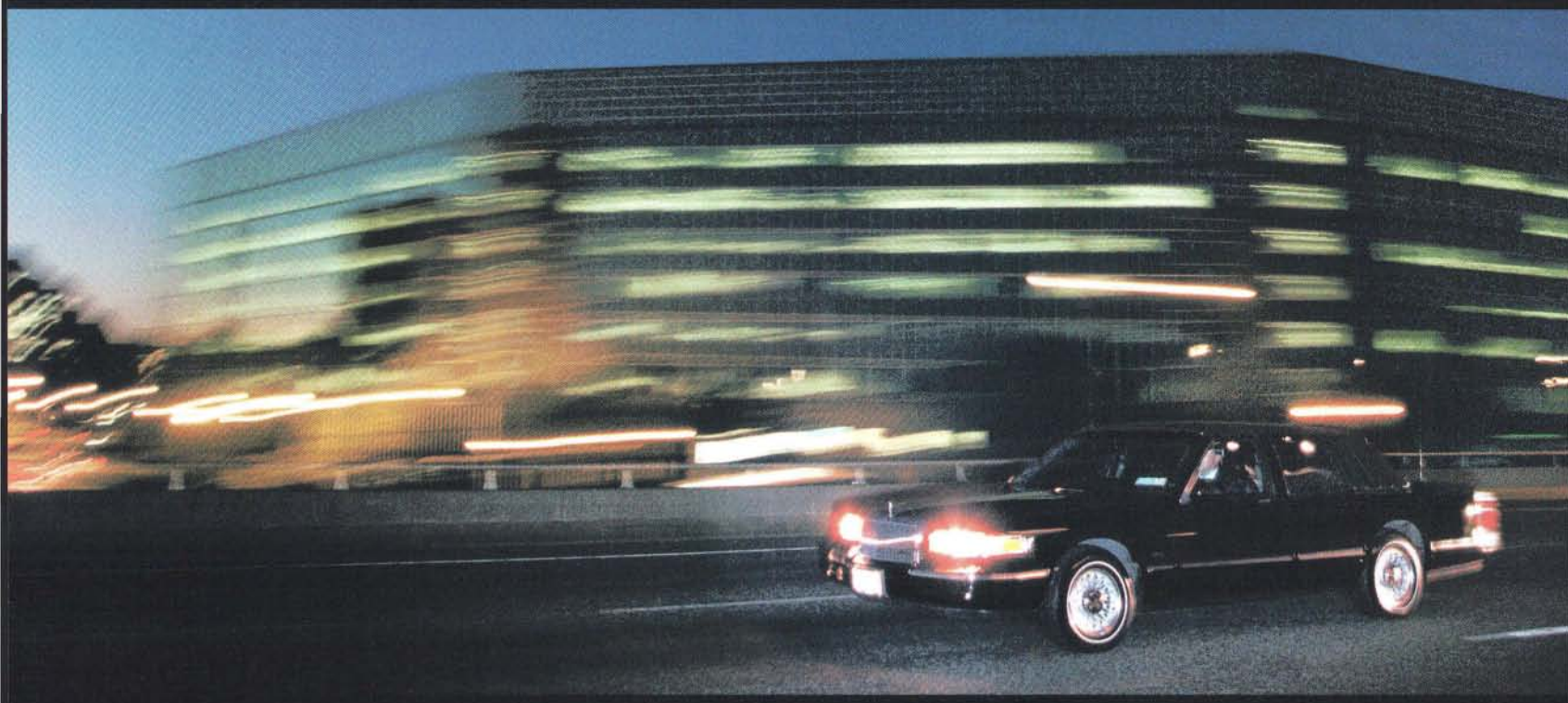

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You Are What You See

By Jay David Bolter

"The Internet has the potential of leading you to increasingly superficial interactions with more and more people." – *Danny Hillis*

Rara avis means "rare bird" in Latin. But if you access the Rara Avis Web site *(www.uky.edu/FineArts/Art/kac/raraavis.html)*, you can have a visual experience that is becoming increasingly common on the Internet. The site presents images captured by a digital camera in an Atlanta art exhibit, where the camera was embedded in the head of a parrotlike "macowl" figurine. Through this electronic eye, you could watch the visitors watching you. You could experience the exhibit from the parrot's point of view.

Computer graphics is showing itself to be a technology for generating points of view. For decades, the computer has been used to study the world through numerical analysis or comment upon the world in text. It is now becoming literally a way of seeing the world. The computer has something in common with earlier perspective technologies – painting, photography, film, television – but it is unique in its capacity for interactivity. In immersive virtual reality and even certain games, the computer gives the user not only a point of view but control over that point of view. This control allows the user to define her- or himself by choosing a place in the virtual world. Computer graphics isn't just about morphing objects; it's about morphing the view and the viewer.

Email, newsgroups, chat rooms, MUDs, and MOOs are worlds created out of words, and in these domains our identity is not fundamentally different from what it has been in the world of print. We define ourselves by what we write, just as we have done for hundreds of years in letters, diaries, and printed books. In computer graphic environments, however, we define ourselves by what we see when we look out through electronic eyes.

Visual media are now threatening to take over a crucial cultural task that until now has belonged to verbal media. Conservatives like William Bennett want children to read classic printed books so that they will adopt appropriate points of view (he calls them "virtues"). Conservatives see television as the destroyer of these virtues, and they're right, in a sense. But it is not the implied sex or violence of MTV that poses the threat. It is the schizophrenic POV camerawork, which rejects the consistent verbal identity of the age of print. In this respect interactive computer graphics pose a far greater threat than MTV. Both gentle *Myst* and violent *Doom* subvert the values of print more than does a music video by Madonna, who is herself just a caricature of traditional values. *Myst* is really about superseding, even destroying the book and along with it traditional verbal identity. Action-adventure games, too, are exercises in visual identity, encouraging users to think of themselves as a moving and changing point of view.

Interface designer and cyberspace enthusiast Meredith Bricken has written that with VR "you can be the mad hatter or you can be the teapot; you can move back and forth to the rhythm of a song. You can be a tiny droplet in the rain or in the river; you can be what you thought you ought to be all along. You can switch your point of view

We're Not Evolving

By Jef Raskin

It's a common misconception that biology says species are always evolving. Take the suggestion that poorly designed keyboards will favor natural selection of "those über-arms of our future," that "evolution will yield comfort." Nope.

Babies of cultures that have been circumcising males for centuries are not born without foreskins. And we will not evolve arms better fit for typing from doing lots of it.

Our evolution is more likely to occur in the context of a miserable, dying humanity, bereft of its protective technology. The result may be not the large-cranium creature of science fiction but a nonsentient, carbon-dioxide-adapted monkey. Evolution does not correspond with our notions of "better." Survival is survival. On the other hand, there's genetic engineering ...

Jef Raskin (jefraskin@aol.com) *is best known for creating the Macintosh project at Apple. He is now building a cardboard pipe organ in Pacifica, California.*

Type Held Hostage

By Steve Jones

Typewriters produce a "signature." The mechanical process of striking a key causes deformations that leave a distinct imprint; the ribbon and platen also hold information about what has been written. As a result, investigators have long been able to trace typed ransom notes to specific typewriters. Criminals, in turn, began making ransom notes by cutting and pasting letters from newspapers and magazines.

Though computers provide none of the typewriter's clues, it is often possible to trace trash marks left by defects in a printer's drum or toner cartridge. Spectrophotometry or chromatography can identify which manufacturer's toner was used for laser-printed output, but these processes destroy the original. Electronic ransom notes can be made anonymous, though they may provide a network trail.

In any case, computers have made cutting and pasting an everyday activity, allowing designers – and criminals – to leave as little evidence as possible. Though the PC pushed the development of new fonts, without the typewriter ransom-note type would likely never have been invented.

Steve Jones is chair of the communication department at the University of Tulsa and author of CyberSociety.

"The danger from computers is not that they will eventually get as smart as men, but that we will meanwhile agree to meet them halfway." – *Bernard Avishai*

to an object or a process or another person's point of view in the other person's world." Bricken celebrates the fluidity of virtual, visual identity. Visual identity is not as stable as verbal identity. On the Internet or on paper, you write much the same prose at 70 that you write at 20. MUD players think they can become different people in different games merely by changing their names and their descriptions. But their underlying written voice, their verbal character, is often hard to disguise. On the other hand, you don't "express" yourself in defining your computer graphic identity. Instead, you occupy various points of view, each of which constitutes a new identity – whether of a parrot or a flying logo. You adopt these identities one at a time, but you don't need to (and aren't likely to) keep any one for long. Unlike characters in 19th-century novels, you don't make fateful, lifelong commitments. You change identities with the same playfulness with which you click through pages on the Web.

This fluidity creates a new type of freedom, at first defined in spatial and visual terms. But as with all freedoms, there are corresponding responsibilities. Visual freedom obliges us not just to sympathize, but to identify with other people. We do this by occupying their point of view technologically – by walking (or flying) a mile in cyberspace wearing their headmounted display.

Television already performs this function in our culture. Television puts you on the scene of every natural and technological disaster and insists that you watch and feel the victims' pain. Interactive computer graphics can vastly improve on television's ability to put you there. The CNN Interactive Web site provides recorded audio and video for its regularly updated news reports (frequently disasters and sporting events, which are always invitations to empathize). Meanwhile, digital cameras on the Internet monitor professors' offices, students' dorm rooms, and congested expressways. All such sites are invitations to share an experience. A Web page from the University of Washington *(www.cac.washington.edu:1180/)* allows everybody on the Internet to experience the current reality of Seattle weather. Then there are the cameras trained on pets: goldfish, guinea pigs, cockatiels. These sites too are exercises in identification. The camera seeks to put you in close, empathetic contact with the animal. It is a short step to the Rara Avis site, where the camera fully occupies the animal's perspective. We can't be far away from "live" Internet video of a natural disaster – the world from the point of view of a hurricane or tornado.

Freedom in the age of print was the freedom to write and read, also called freedom of the press, indicating its connection to the technology of printing. We might also call it "freedom of verbal point of view," because what the age of print valued was the right to define one's identity and beliefs through speaking and writing. That isn't to say the older freedoms of expression are not worth protecting on the Internet. They are. But they matter most to those whose values were formed in and by the age of print.

Those who have opposed the Communications Decency Act argue that the Internet is more like a printed book than like television. For

Behind the Curtain

By Tom Claburn

Inaccessibility is the cornerstone of power. The heroes of our imagination inhabit fortresses of solitude rather than more public spaces. Those who have access to the powerful and celebrated are the modern hierophants, the priests and courtiers inside the castle walls. To communicate with the exalted, you used to have to know someone, or pay someone. You still do, but the packets of data traversing the Net are hammering at the walls. When the dust has cleared, we may find that with access comes a diminution of our political and cultural icons, as happened when Dorothy pulled back the curtain to reveal the little Wizard of Oz. Perhaps the 15 minutes of fame Warhol predicted for everyone anticipated the shift from trickle-down, representative democracy toward something more egalitarian.

Tom Claburn (tom@wired.com) *is production coordinator at* Wired.

Singapore Sling

By Matthew Doull

Liberty-loving webmasters should append the following short message to the bottom of every page they serve: "The government of Singapore sucks." Why? Because those five words fall foul of Singaporean standards of political correctness, and their poxy proxy servers would be prevented from letting anyone in Singapore access any page that carried it. If Singapore won't let the whole of the Web in, the whole Web shouldn't let Singapore in.

But why bother when the Singaporean experiment is doomed to failure anyway? The free flow of information on the Internet has nothing to do with dirty words and everything to do with power. And it's time governments got the message about where power now lies. Freedom of information enhances the spread of political freedom and economic freedom – because information, power, and money are the same thing. In other words, free your Internet and your ass will follow.

Matthew Doull (mdoull@suntimes.com) *is president of Hollinger Digital, but his views are his own.*

"America I'm putting my queer shoulder to the wheel." – *Allen Ginsberg*

BLOW UP COWS, EAT GOLDFISH, THEN GO TO HELL.

This is the bizarre world of Baldies. A world that you build and where lunacy reigns. The idea? Destroy the nasty little hairy guys before they destroy you–the Baldies. 15 devilishly clever weapons, 100 intense levels, hidden and bonus rounds, hot action graphics in five weird worlds (hell included). And it's the only multi-player, extended-play game with a chrome dome crew. Warning: May cause permanent hair loss.

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them, the Internet is a world of newsgroups and chat rooms discussing issues like breast cancer and abortion, and so it deserves the same First Amendment protection accorded printed materials. The government has argued that the Internet is like television, a cascade of images – mostly, authorities seem to think, pornographic images. For our visual culture, images are more immediate than words and therefore more dangerous. So our culture censors pictures more vigorously than words, and moving pictures more vigorously than still images. In this respect those who wish to censor the Internet are right in their assessment of where the power is. With Java and VRML, the Internet is going beyond television to foster a new culture of visually realized point of view. The CDA case will probably go to the Supreme Court, the most print-bound institution Americans have. It will be interesting to see whether the nine justices recognize the Internet as a new kind of book or as television out of control.

But one thing seems certain. The Supreme Court justices won't recognize the real threat (that is, to the old culture of the Enlightenment, which gave us our constitutional republic in the age of print). If they did, they wouldn't worry about banning pornography, certainly not written pornography. Instead, they would ban inexpensive digital cameras, graphic accelerator boards, 3-D rendering software, and, above all, the freedom to merge your point of view with that of a raindrop. This freedom, to which the Founding Fathers were oblivious, is giving us a new definition of the self in cyberspace.

Jay David Bolter **(jay.bolter@lcc.gatech.edu)** ***is a professor at the Georgia Institute of Technology.***

"If you assume that there's no hope, you guarantee that there will be no hope. If you assume that there is an instinct for freedom, there are opportunities to change things, there's a chance you may contribute to making a better world. That's your choice." – *Noam Chomsky*

"Encryption is a powerful defensive weapon for free people. It offers a technical guarantee of privacy, regardless of who is running the government. It's hard to think of a more powerful, less dangerous tool for liberty." – *Esther Dyson*

One-Way to Mars?

By Henry Spencer

The hard part of an expedition to Mars isn't getting there, but coming back. More than three-fourths of what is launched to Mars is the return vehicle, supporting equipment, and fuel: 136 metric tons to return a crew of four.

So why bring them back?

That isn't as silly as it sounds. You might think, Well, we can't send people up there to die ... But everyone dies eventually. If the members of the crew are about 35 years old, with good medical care and a bit of luck they can expect to live another 40 years. Why not spend them on Mars?

To do so, the crew needs air, water, food, and spare parts. Mars has water, and an atmosphere that can be chemically processed to produce breathable air. The main problem is food, and that's about a kilogram per day per person. With spare parts plus odds and ends, the supplies we have to ship from Earth are perhaps half a ton per year per person.

That means 40 years of supplies is only about 20 tons per person; a fully fueled return vehicle is about 34 tons per person. It's actually *easier* to send a lifetime of supplies! We also eliminate worries about contaminating Earth with Martian bacteria: no return trip means no contamination.

Would people volunteer to spend the rest of their lives exploring a new planet? That question was asked at the recent Case for Mars technical conference – and about one-third of the audience said they would.

Henry Spencer **(henry@zoo.toronto.edu)** ***is an author and a consultant in both computing and spaceflight.***

"Beware of bugs in the above code; I have only proved it correct, not tried it." – *Donald Knuth*

One Way to Mars

By Spencer Reiss

There's a one-word answer to paying for a one-way trip to Mars: television. Any guess what, say, Rupert Murdoch might part with for exclusive rights to the greatest epic in modern history? Telegenic crew. Life-and-death drama. Live video from 25 million miles out. And the first landing on another planet – an easy bet for the most-watched event ever.

NBC is laying out US$715 million for the 2000 Olympics, a two-week event. For a one-way Mars mission, the price tag starts around $15 billion – $500 million a year for a 30-year run. And we haven't even talked about which shoe company gets its logo on the first foot to touch Martian soil. Just do it.

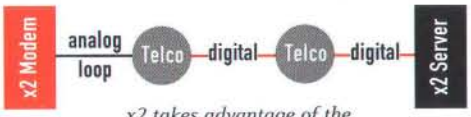
Spencer Reiss **(spencer@wired.com)** ***is all set to watch.***

Introducing the 56K download
over analog phone lines.
Introducing the next generation
of Internet access.
Introducing the new standard
for online speed.
Introducing x2™ Technology from
US Robotics®

The Biggest Breakthrough In Online Communications

For years, 33.6K was thought to be the practical transmission speed limit over analog phone lines. Not any more. New x2™ technology from U.S. Robotics shatters this barrier. Now you can get up to 56K of actual transmission speed when you download.

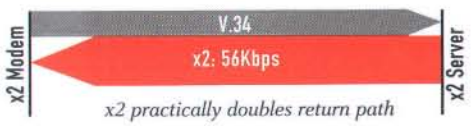
This revolutionary breakthrough is brought to you by the advanced team of engineers at U.S. Robotics. Their knowledge of the increasingly digital telephone system makes x2 possible. x2 takes advantage of the typical network configuration found when an analog subscriber connects to a digitally connected server. Because it bypasses the analog-to-digital conversion in the downstream path, x2 can use nearly all of the available 64K network bandwidth.



x2 takes advantage of the highly digital phone network.

(Upstream data, typically less speed sensitive, travels at the standard V.34 rate.)

The result is a completely new kind of transmission technique. Based on "encoding" rather than "modulation," it can give you download speeds that you never thought possible. What's more, with standard V.42 *bis* compression, x2 can download at speeds up to a blistering 230.4K.



x2 practically doubles return path

Whether you're surfing the net, telecommuting from home, or accessing information from a mobile location, x2 can help you get what you want, when you want it.

Only U.S. Robotics Can Bring You x2 Technology

U.S. Robotics is uniquely positioned to bring you this breakthrough. We are the #1 provider of information access solutions in the world today. That's because our communications products are favored on both the server and end-user sides. This is important, since a communication technology must be in place on both ends of the connection to work properly for you.

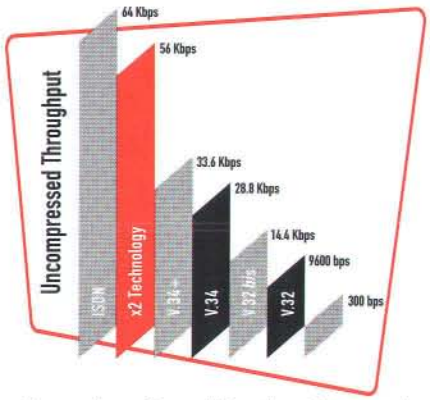
56K. It's not just a new kind of modem. It's a new

Connecting More People Than Anyone Else In The World

U.S. Robotics Total Control™ Enterprise Network Hubs are widely used by Internet service providers, corporate sites, and online services. Our Megahertz® brand is the leading choice for mobile users. And more people choose Sportster® modems than any other desktop brand. All told, no company puts more communication power into the hands of more people throughout the world than U.S. Robotics.

x2 technology is being supported by over 30 industry leaders worldwide. These include:

America Online · CompuServe · IBM · MCI



Comparison of actual line throughput speeds.

Creating The Next Worldwide Standard

As the first company to bring you 14.4K, 28.8K/V.34, and 33.6K technology, U.S. Robotics is the leader in blazing the trail toward faster standards. In fact, we've already submitted x2 to the ITU-T board, and expect it to become the standard of the future.

But greater speed is in demand right now. And, because x2 was designed to work with existing V.34 standards, we're able to bring it to you.

Offering x2-Capable Products To Meet Every Need

Sportster, the world's #1 selling modem, is now shipping in an easily upgradable version, and has been since August 1996.

Our Total Control™, NETServer, MP, and Courier™ products are flash ROM upgradable, with no extra equipment to buy.

And our Megahertz® PC Cards will be x2-capable beginning in early 1997.

Whatever your needs, you know they'll be met at incredible speed–and a reasonable price–whenever you see the x2 logo.

kind of technology.

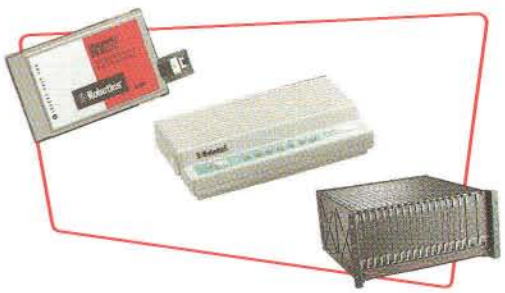
Supported By Major Internet Service Providers

America Online, CompuServe, and MCI are just some of the more than 30 ISPs worldwide that are implementing x2™ in their access servers. With such overwhelming support, x2 will become the technology of choice for anyone who wants the very fastest in online connections.

Simply check our website to find out if your ISP supports x2 technology, or contact them directly.

Adopted By Industry Leaders

x2 has been embraced by every sector of the communications industry, including major retailers, chipset makers, and original equipment manufacturers. This widespread acceptance ensures that x2 will be available to you on a variety of platforms, both now and in the future.



U.S. Robotics features a complete line of x2-capable products.

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The breakthrough you don't have to wait for.

A graphic download at 14.4K speed.

In the same amount of time, a 28.8K modem downloads this much.

While x2 Technology's 56K speed gives you the whole picture.

US Robotics 56Kbps modem TECHNOLOGY

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Now, busy work-at-home professionals can replicate Notes™ files, download spreadsheets, and access their corporate intranets faster than ever. With x2 on both ends of the communication chain, you'll see a remarkable savings in time. And in today's business world, time is money.

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You can find x2-capable modems from U.S. Robotics on the shelf today wherever you buy computer products. Just look for the x2 technology logo. It's your guarantee that you'll be able to upgrade quickly and easily to the fastest connection speeds available over regular phone lines today.

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"I was addicted to junk"

"**It started as a weekend thing.**

A few hits on Netscape,
some experimentation with Explorer.
At first it was
strictly 'recreational'.
Before long it became a habit.

A filthy habit.

Soon I was cooking my own,
hacking night after night
with **bad** tools, **bad** code, **bad** hygiene.
I told myself I could quit anytime.
I was wrong.
I thought I could control it
with **plugins, Java, ActiveX.**
They only made it worse.
My homepage was all messed up,
and everyone could see it but me.
I could feel myself
heading for a crash. A real bad **crash.**

That's when the monkey spoke."

www.webmonkey.com

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Happy Birth

The HAL 9000 computer – an artificial intelligence that could think, talk, see, feel, and occasionally go berserk – was supposed to be operational in January 1997. Has anyone seen HAL? By Simson Garfinkel

If you take *2001: A Space Odyssey* literally, then right about now, somewhere in Urbana, Illinois, an intelligent machine is stumbling through a pathetic version of the song: "Daisy, Daisy, give me your answer, do...." January 12, 1997, is the birthday of HAL.

Four years later, after a hell of a lot of additional lessons, HAL and five human crew members are on the spaceship *Discovery* approaching Jupiter. By that time, HAL has been charged with protecting his passengers and ensuring the successful completion of the secret mission. He even has the capability to complete the mission on his own, should something happen to the crew. "My mission responsibilities range over the entire operation of the ship, so I am constantly occupied," HAL confidently tells a BBC newscaster during a television interview. "I am putting myself to the fullest possible use, which is all, I think, that any conscious entity can ever hope to do."

That's when something goes wrong – terribly wrong – with *Discovery*'s human crew. HAL detects a problem with the AE-35, a piece of equipment used to maintain contact with Earth. But after Dave Bowman goes on a space walk and brings the AE-35 back in, neither he

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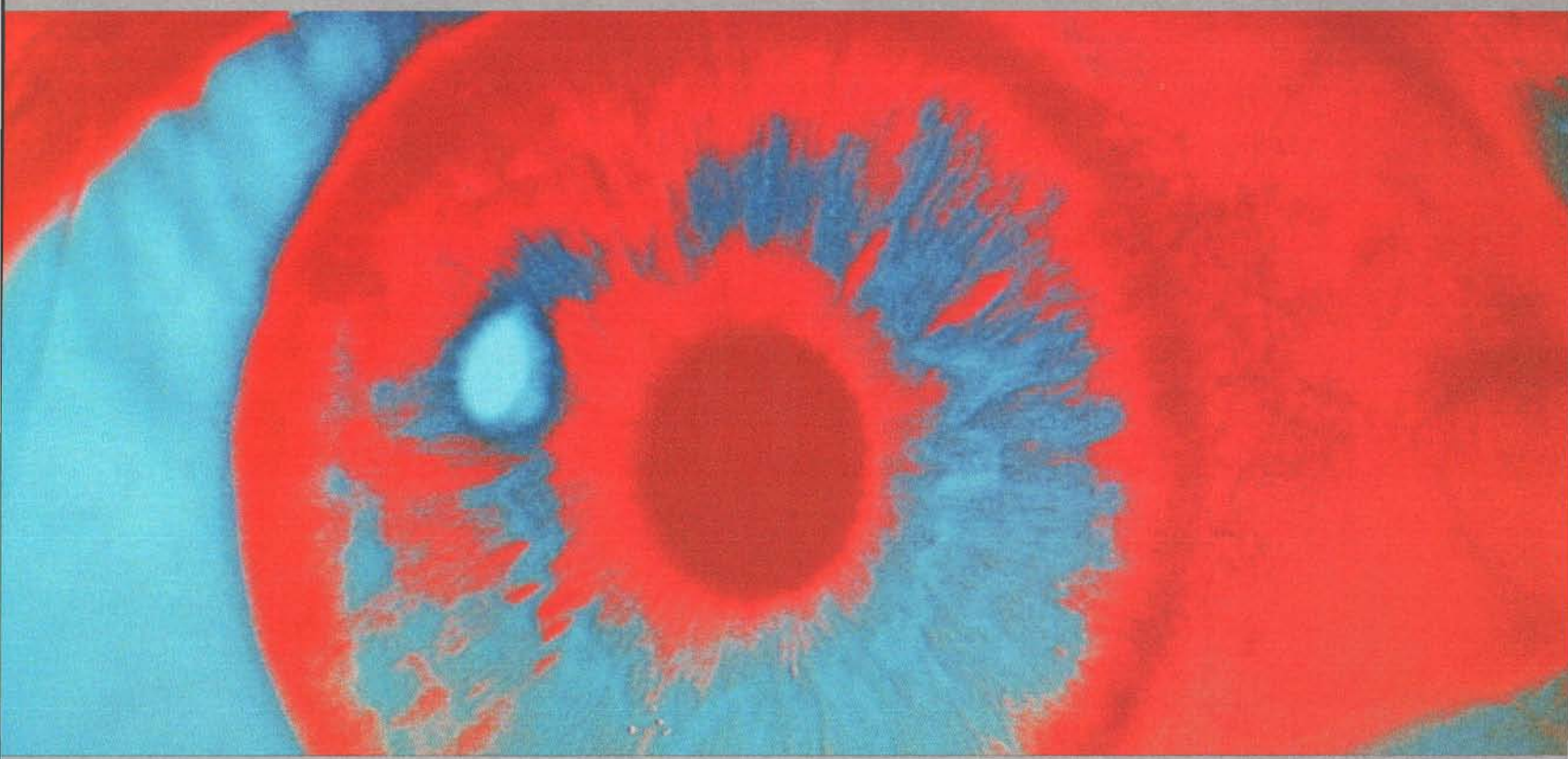
day, HAL



nor Frank Poole can find anything wrong with it. So they blame HAL: they conclude that the computer is malfunctioning and decide to shut him off.

Realizing that the humans' actions would jeopardize the mission, HAL does his best to defend himself against their treachery: he kills Poole during the next space walk, then traps Bowman outside the ship when he foolishly attempts a rescue. As a precautionary measure, HAL also terminates the life functions of the three hibernating crew members.

Outside the spaceship, Bowman argues with HAL over the radio, demanding to be let back in. The computer wisely refuses: "I'm sorry, Dave, I'm afraid I can't do that." That's when the wily Bowman maneuvers his space pod to *Discovery*'s emergency airlock, blows the explosive bolts, scrambles inside, seals the door, and repressurizes the airlock. Finally, Bowman makes his way into the core of HAL's brain and disconnects his higher brain functions, one by one.

Today the results of Bowman's actions are well known: He leaves the spaceship to face the alien artifact on his own. *Discovery* never returns to Earth. The mission ends in failure.

Still swinging clubs

When Arthur C. Clarke and Stanley Kubrick created the film *2001* almost 30 years ago, they subscribed to a kind of scientific realism. Repulsed by the space operas that had come before, they depicted spaceflight as slow and silent. Likewise, Clarke and Kubrick tried to make the HAL 9000 as advanced as they thought a computer could possibly be in the year 2001, while still remaining plausible.

Though Clarke and Kubrick might have gotten the physics right, their technological time line was woefully inaccurate: we are far behind the film's schedule today. The story depicts a huge space

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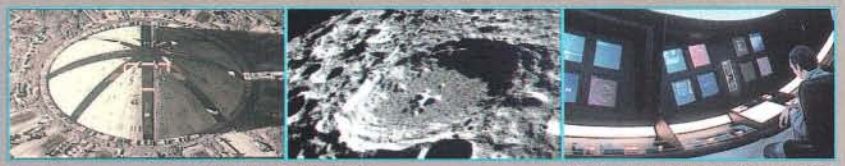
Simson Garfinkel (simsong@vineyard.net) *is spending six months at the University of Washington in Seattle exploring the future of computers and society.*

THE WORLD ACCORDING TO CLARKE

Nearly 30 years ago, Arthur C. Clarke and Stanley Kubrick tried predicting what the world would be like in 2001. Let's just say that a lot of shit has to happen in four years.

THE WORLD IN 2001 ▶ MOON INHABITED BY EARTHLINGS MAINFRAMES AND TYPEWRITERS



THE WORLD IN 1997 ▶ MOON AN EMPTY ROCK PERSONAL COMPUTERS AND LAPTOPS

SPACE SHUTTLE COMBAT BOOTS FOR THE GRRRLS COLD WAR LASTED (NEARLY) HALF A CENTURY ►

station and space weapons in Earth orbit, routine commercial spaceflight, and two colonies – one American and one Russian – on the Moon itself. Perhaps this will come to pass in another 30 years, but it seems unlikely. Today, we can't even return to the Moon.

Further, Clarke and Kubrick failed to predict the biggest advance of the past 20 years: miniaturization and microelectronics. In the film, astronauts on the Moon use a still film camera to take pictures of the alien artifact; today we would use a digital videocamera. Aboard *Discovery*, Bowman and Poole use pen and paper to take notes; there are no laptop computers or PDAs to be found anywhere. Likewise, the control panels of the film's spaceships are filled with switches and buttons; Kubrick and Clarke failed to anticipate the glass cockpits that are becoming popular today.

But what about HAL – a fictional computer that is still far more advanced than any machine today? Is HAL another one of Kubrick's and Clarke's mispredictions? Or were the two simply a few years early? Indeed, HAL acts much more like a human being trapped within a silicon box than like one of today's high-end Pentium Pro workstations running Windows 95. Throughout the film, HAL talks like a person, thinks like a person, plans – badly, it turns out – like a person, and, when he is about to die, begs like a person. It is HAL's ability to learn and his control of the ship's systems, rather than his ability to perform lightning-fast calculations, that make him such a formidable challenge for the humans when they try to disconnect him.

Is this 1960s vision of the future of machine intelligence still realistic today? Yes, although not on the timetable set forth in either the film or Clarke's novel – which further muddle the issue by placing HAL's birth five years apart. According to the book, the HAL 9000 computer was activated on January 12, 1997. But in the film, HAL says that he was activated on January 12, 1992 – a Sunday. (Why the confusion? Kubrick presumably wanted HAL to be nearly 9 years old when he died so his death would be more poignant. Clarke, meanwhile, saw the foolishness of sending a 9-year-old computer on the most important space mission of all time.)

"Certainly we can do some things as well as HAL," says David Stork, a consulting associate professor of electrical engineering at Stanford University who has made HAL one of his obsessions. "We have a chess program, Deep Blue, that beats all but a dozen people in the world, and it's improving every year. Likewise, we can build big computers. Building a computer with the power necessary for performing HAL's functions is within our grasp." Stork estimates that a network of a few hundred supercomputers could handle the computational requirements easily enough.

Some of the tasks HAL performs in the movie are commonly done by computers today. HAL guides *Discovery* to Jupiter; almost 20 years ago, the United States launched two unmanned Voyager spacecraft, which were largely guided by onboard computers, to Jupiter, Saturn, Neptune, Uranus, and beyond.

Likewise, the past 20 years of research and development of artificial intelligence have had tangible benefits. Just look at AT&T, which has been phasing in a speech-recognition system that can understand the words "collect," "calling card," "third-number," "operator," "yes," and "no." That doesn't seem like a hard job – for a person. Try writing the program and you'll soon be coping with hundreds of kinds of accents, high levels of background noise, and different kinds of distortion introduced by different kinds of phone lines and telephone instruments.

Building a system that can recognize just those six words has taken AT&T more than 40 years of research. Now in place, the system is allowing the company to phase out some of its human operators – which means spending less on salaries, wages, benefits, real estate, maintenance, overhead, and more. Total estimated savings? About US$150 million a year. It's possible that speech recognition saves AT&T more in a single year than the firm ever spent on the research, but it's impossible to say for sure because the company won't release breakdowns of the budgets for Bell Labs.

Of course, there's still a big jump in intellect between the AT&T machine that can recognize six words and HAL. And we're still a long way off from getting a machine to truly think and learn. That's a problem that has been haunting the AI field for more than 50 years.

Don't ask how close the film *2001* came to getting the technology right. Ask how close today's computers are to realizing the promise of HAL. When will *2001*'s dream become reality?

This month, MIT Press is publishing Stork's book *HAL's Legacy: 2001's Computer as Dream and Reality*, a collection of essays written by some of today's top researchers in the field of computer science. Much of *HAL's Legacy* plays a kind of guessing game with the film: how close did Clarke and Kubrick come to getting the technology right? For example, Donald Norman, Apple Fellow and vice president for Apple's Advanced Technology Group, takes a punishing look at the lack of good ergonomics in the spaceship *Discovery*'s control panels.

But flip the question around and the game can be even more interesting. Don't ask how close *2001* came to being right. Ask how close today's computers are to realizing the promise of HAL. When will we be able to talk to a HAL-like computer and consider it nearly an equal? When will the dream of *2001* become reality?

Perhaps the easiest way to answer that question is to take a step-by-step look at what it means to be HAL.

The ultimate chatterbot

Unlike today's computers, the primary way HAL communicates with *Discovery*'s crew is through the spoken word. Bowman and Poole speak; HAL listens and understands. How far are we from a computer that can comprehend its master's voice?

Voice recognition is a hard but largely solved problem. For more than five years, two companies in the Boston area – Dragon Systems and Kurzweil Applied Intelligence – have sold programs that let you command a personal computer using your voice. These programs get better every time PCs get faster. Today they can recognize more than 60,000 words and control a wide variety of PC applications, including wordprocessors and spreadsheets. The Dragon and Kurzweil programs are widely used by people who can't type because of a physical disability. Increasingly, they are finding a market among people who simply haven't learned to type or haven't learned to spell.

But the Dragon and Kurzweil systems can be difficult to use. Unlike HAL, which could listen to people speaking in a continuous flow, today's systems require that you pause between each word. The programs use the pauses to find where each word begins and ends. The computer then looks up the word in a phonetic dictionary, creating a list of possible matches. An elementary knowledge of grammar helps these programs pick the right word and resolve the difference between homonyms like "write" and "right."

Continuous speech systems use the same kinds of algorithms as today's word-by-word systems but have the added burden of figuring out where each word starts and stops. Making those decisions requires substantially more computing power.

Both Janet Baker, president and cofounder of Dragon Systems, and Ray Kurzweil, founder and chief technical officer of Kurzweil Applied Intelligence, claim they have systems in their respective laboratories that don't require the speaker to pause between words. "We demonstrated the first continuous recognition machine a few years ago," says Baker, who maintains that her continuous speech system could handle a vocabulary of 5,000 words. Kurzweil's labs, meanwhile, have built a system that can recognize a thousand different commands used by Microsoft Word. "You could say, 'Go to the second paragraph on the next page and underline every word in the sentence,'" says Kurzweil.

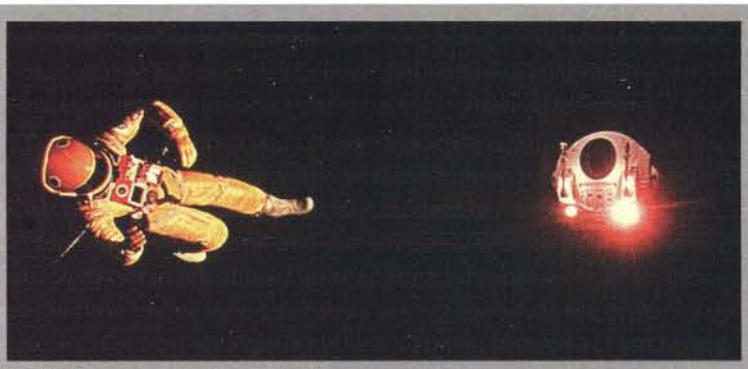
Both Baker and Kurzweil believe that commercially viable continuous voice recognition systems are just around the corner – say, another two or three years off. Already, both of their commercial products allow continuous voice recognition of numbers. You can, for example, say a phone number without pausing between the digits. But neither company would demonstrate its continuous speech system for a reporter. Presumably, they're not quite ready for prime time.

Bottom line: We're close to reaching HAL's level of speech recognition, and progress is picking up. By 2001, we should have it.

Read my lips

HAL can do more than understand spoken words – the computer can also read lips. In one of the film's pivotal scenes, Bowman and Poole retreat to one of *Discovery*'s sealed pods to have a private conversation. HAL watches their lips through the window and realizes that the two humans may attempt to disconnect his brain.

HAL's mind game: Dave stares back.



HAL's handiwork: Frank drifts away.

Is computerized lipreading possible? Arthur C. Clarke didn't think so – not by 2001, not ever. "He thought there was just not enough information in the image of the talker," says Stork, who worked with Clarke on *HAL's Legacy*. Clarke didn't even want the scene put in the film. It was inserted only at Kubrick's insistence for dramatic effect.

Thirty years later, the debate over the efficacy of pure lipreading – even in humans – still is largely undecided. Wade Robison, a professor of philosophy at the Rochester Institute of Technology, where 1,000 of the school's 9,000 undergraduates are profoundly deaf, is sure that lipreading is possible because human intelligence can master it. Robison remembers one student in particular: "I hadn't a clue she was deaf until one day I happened to be talking one-on-one with her in my office. I finished up a sentence as I turned to answer the phone, and she had to ask me to repeat the sentence. As I turned, I almost jokingly mouthed: 'Can you hear what I am saying now?' She said, 'Yes, but I'm reading your lips.'"

Other researchers disagree that the image of the speaker is enough. "We have tested people who supposedly could get by 186 ▸

Space Stations: Economy and Deluxe

When it comes to building space stations, we're still trying to invent the wheel. Today's state-of-the-art space station *Mir* is more like a heap of orbiting junk than the vast gyrating structure envisioned in the movie *2001*. Kubrick and Clarke's creation generated its own gravity, contained dozens of rooms, and had enough space for separate Soviet and US sectors – plus a lobby for passport control. Today, no more than a handful of US and Russian astronauts can bump heads in *Mir*, the human race's sole place in space.

Dave Bowman jogging on the spacious spaceship *Discovery* in the year 2001.

Charles Precourt squeezing into the cramped space station *Mir* in 1995.

EVIDENCE OF LIFE ON MOON

EVIDENCE OF LIFE ON MARS

SOVIET UNION

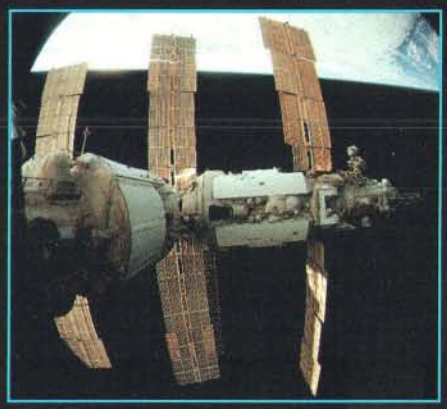
RUSSIA

WORLDWIDE, POPULATION-INDUCED FAMINE

ISOLATED, POLITICS-INDUCED FAMINE

ASSOCIATED NEWS ▶

CNN ONLINE ▶



The real space station *Mir* in 1995 (definitely not to scale).

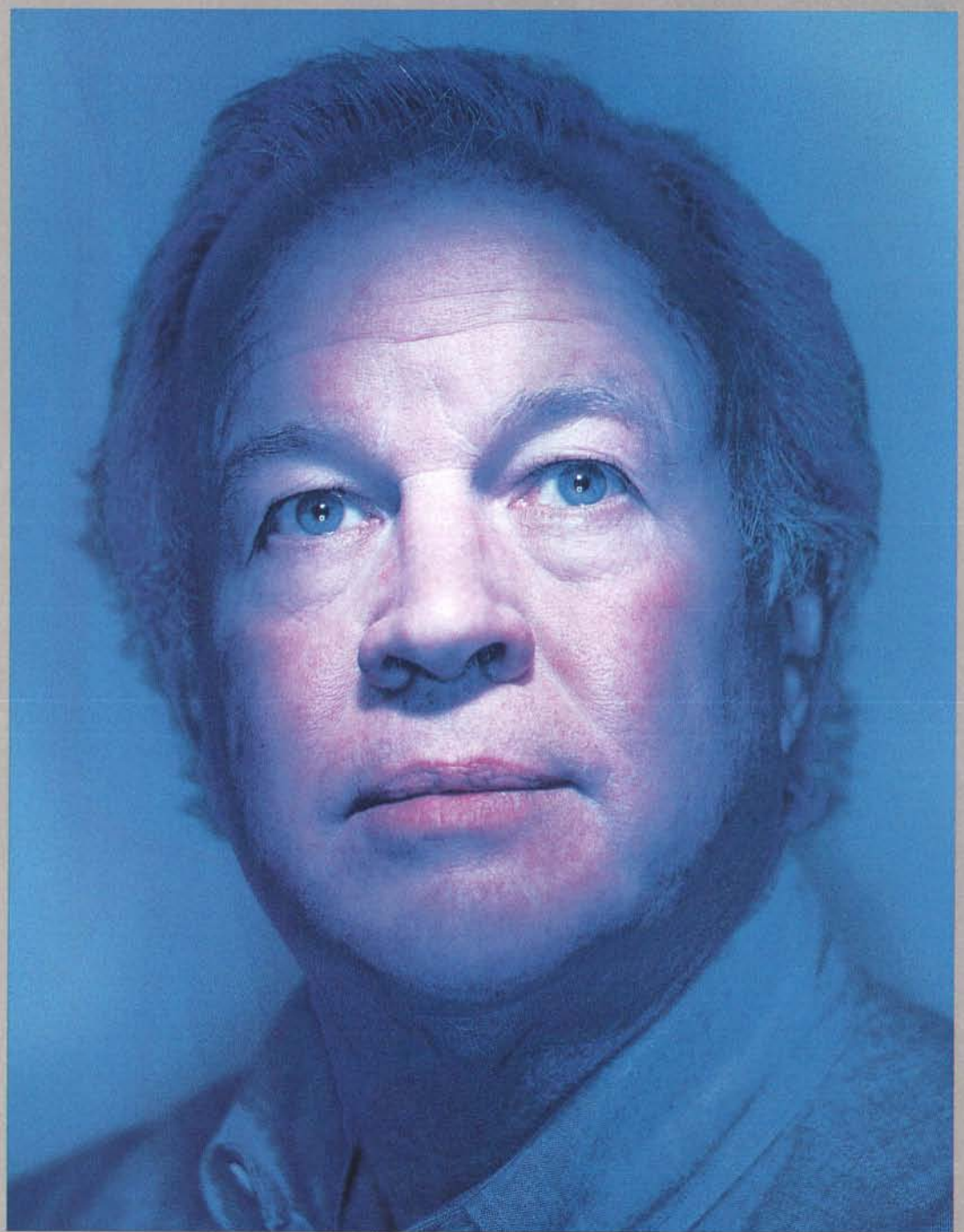
2001 ►

PAN AM'S 26-HOUR FLIGHT TO THE MOON

1997 ►

PAN AM SHUTTLE

Trumbull's Vision

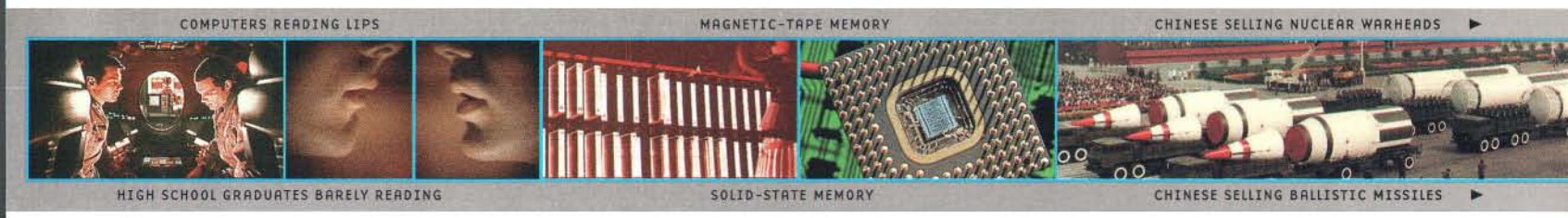


A mere 30 years ago, there were no personal computers. Laptops were a fantasy; even *Pong*, the triceratops of computer games, was years away. Still, the mid-1960s were the can-do days of American technology, and when Stanley Kubrick decided to make a science fiction film called *Journey Beyond the Stars*, he wanted it to look *real* – real in a way that no sci-fi film had ever looked before.

Kubrick recalled a documentary he'd seen in the Travel and Transportation pavilion at the 1964-1965 New York World's Fair. Graphic Films, which specialized in making space industrials for NASA and the US Air Force, had produced the movie, and one of its visionaries was a 23-year-old named Douglas Trumbull. Trumbull eventually became one of the four special effects supervisors hired by Kubrick to realize his own vision – a film ultimately renamed *2001: A Space Odyssey*.

Over the past three decades, Trumbull has become the godfather of other-worldly special effects. His credits include *The Andromeda Strain*, *Close Encounters of the Third Kind*, *Blade Runner*, as well as *Silent Running* and *Brainstorm*, both of which he also directed.

Trumbull is now vice chair of IMAX – arguably the world's cutting-edge producer of immersive cinema – as well as president and CEO of Ridefilm Corporation, which produces motion-simulation experiences.



He invented modern special effects with his work on *2001*. Now Douglas Trumbull believes that the future of special effects is beyond movies. By Jeff Greenwald

Wired: *2001: A Space Odyssey* is one of the most beautiful films ever made. It has a sense of being shot on location that may have come partly from the analog special effects you used back then. Do you think *2001* would be as beautiful if it had been made today using digital effects?

Trumbull: Yes. My particular aesthetic of light and color and design wouldn't change as a result of working with computer graphics rather than with slit scan or miniatures. There's a consistency in my work that pops up independent of the limitations of the technology.

What was the greatest technical challenge of working on *2001*?

The biggest challenge, and the most satisfying for me, was the Star Gate sequence [in which astronaut Dave Bowman is transported, via the monolith, into an alternate universe]. It was the point where things became much more abstract and less literal than in the bulk of the film, which was hardcore rockets and space and planets – all a fairly straightforward evolution from what I had been doing before.

If you could do it over again with the technology you have now, would your approach to that sequence be different?

Clearly, if we'd had the kind of computer graphics capability then that we have now, the Star Gate sequence would be much more complex than flat planes of light and color. It probably would have gotten into a lot of weird geometries, and turns, and shifts of angle. I just had a straight track and some straight pieces of glass. The technology of the time dictated the way things looked.

What was your relationship to HAL?

My first job on *2001* was to make all of the HAL readouts: the 16 screens that surround HAL's eyes. They actually were rear-projected films – I made all of them. But as far as the concept of HAL, who HAL was, his character – I had no role in creating him.

Did computer companies help with designing HAL?

IBM was the original contractor for much of the computer interface design on the film. There were IBM logos designed for the film, and there were IBM design consultants working with Kubrick on the layout of the controls and computer screens. It was only when they found out that HAL was going to go apeshit and kill the whole crew that IBM pulled out of the project and all the logos came off.

How does your work today differ from that of 30 years ago?

When I worked on *2001* – which was my first feature film – I was deeply and permanently affected by the notion that a movie could be like a first-person experience. That the movie could be an immersive experience. *2001* was structured in a way that it doesn't grab you because of its plot construct, or its suspense, or its dramatic narrative mechanisms. It was an immersive visual experience, in 70mm, on giant Cinerama screens. And it actually became, toward the end of the film, a first-person experience. The normal editorial process just went away, and you, as an audience member, sort of became Dave Bowman and went on this trip.

That deeply affected me, and it began my commitment to movies as an immersive experience. In the ensuing 30 years, I've found that it has been harder and harder to make immersive movies because we've multiplexed cinemas into showing films on small, flat screens. The giant, 70mm curved screen format went away, so the palette for delivering immersive cinematic experiences became nonexistent.

I finally came to the revelation that the future of the cinema, in terms of an immersive experience, was occurring outside of mainstream cinema – in theme park rides and attractions and world's fairs. Those were the only places I could ever get the money to continue to work in large formats. That's why I deflected my career from making 35mm, drama-based features to experimenting with these new mediums in alternate venues.

Where do you suppose the next big leap in immersive technology will come from?

In terms of the near future of immersive cinematic entertainment, it's clearly happening at IMAX. That's why I joined the company. Everything in the IMAX theaters is perfected way beyond anything that was ever achieved during the best days of Cinerama.

At present I'm developing an alien contact film project – along with a playwright named Constance Congdon – that'll be shot in 3-D. I hope to get it shot in IMAX and on the screens by next year.

So what *will* the next big leap be?

I honestly believe that the next big leap in immersive technology will be very much like *Brainstorm*. We're not that far from being able to plant images, memories, and emotional states directly into the brain. I think that the whole business of stereophonic sound and virtual reality glasses are a transitory state.

And I've had it confirmed to me – just in the last month – that very powerful work is going on in this direction right now. I visited a scientist who had a helmet with magnetic fields controlled by computer sequences that could profoundly affect your mood and your perceptions.

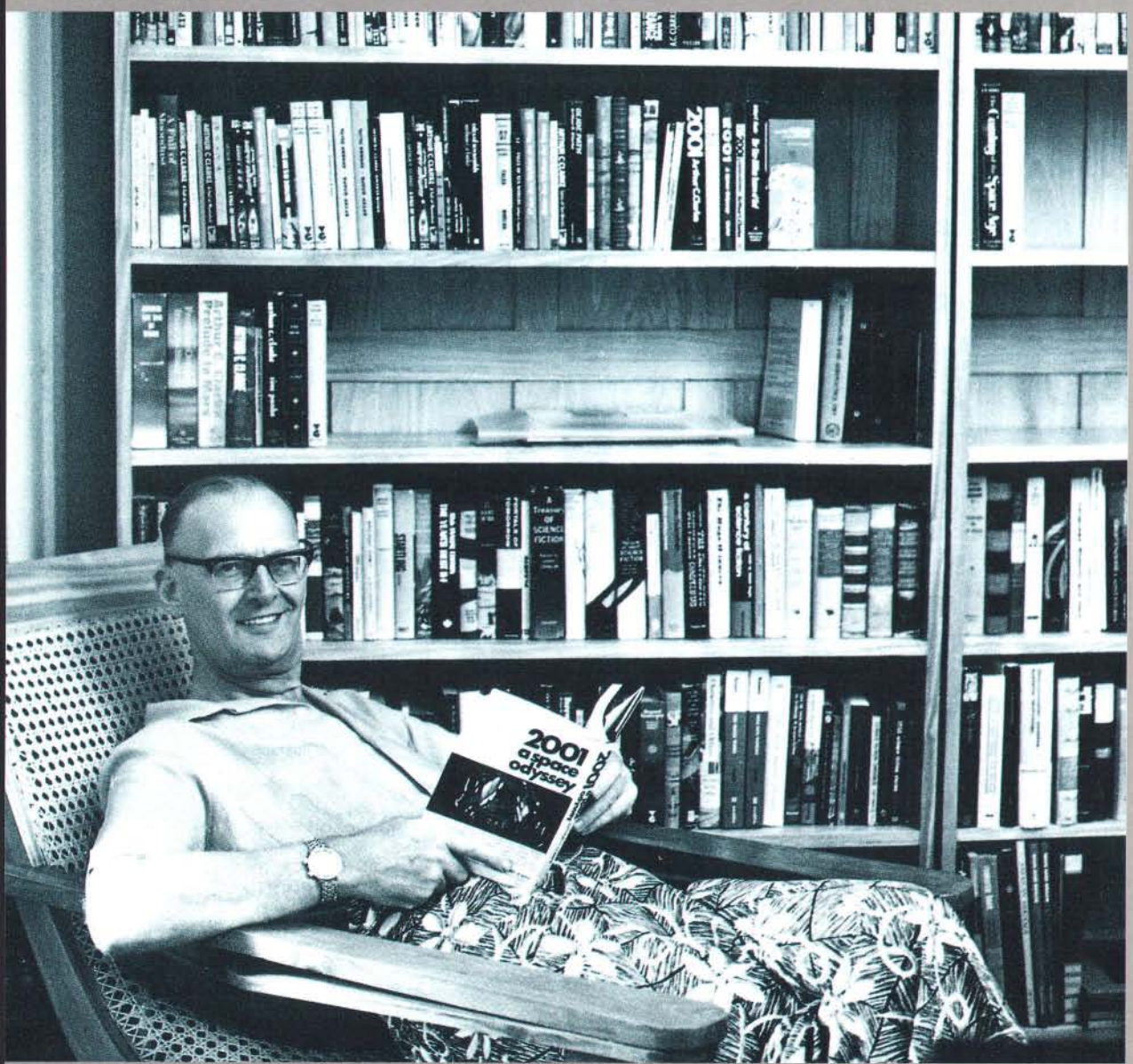
There's some work out there that's going into some really amazing territory. ■ ■ ■

Jeff Greenwald (73541.3207@compuserve.com) *is a contributing writer at* Wired. *He is currently writing a book about* Star Trek *and global culture for Viking Penguin.*

PHOTO: ERIC TUCKER

I Was a Teenage

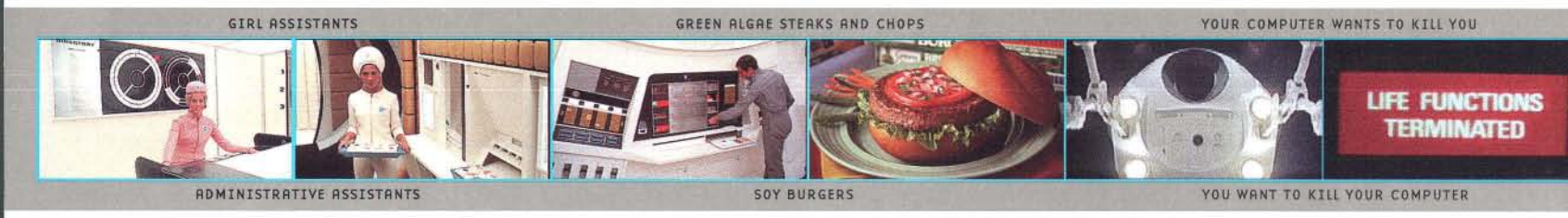
Arthur C. Clarke, that modest genius, talks about HAL in 3001, computers that can take a joke, and the two looming breakthroughs that will get us back on our space odyssey. By Jeff Greenwald



The most disturbing moment in *2001: A Space Odyssey* occurs not around the notorious black monolith, but within the bowels of the spaceship. Astronaut Dave Bowman, having witnessed the murder of his colleagues by HAL, methodically disconnects the computer's intelligence circuits. As he does so, the machine begs for mercy: "Stop, Dave. Stop, will you? I'm afraid. My mind is going. I can feel it...."

HAL's creator, Arthur C. Clarke – who turns 80 this year – is a long way from an equivalent meltdown. Juggling all kinds of new projects despite crippling postpolio syndrome ("My present method of locomotion may best be described as Frankenstein's lurch," he jokes), Clarke has just put the finishing touches on his magnum opus – *3001: The Final Odyssey*.

On the eve of HAL's birthday, *Wired* contributor Jeff Greenwald interviewed the ever-youthful Clarke, who was at his "technoasis" in Sri Lanka.



Centenarian

Wired: Let's clear this up once and for all. What was the original inspiration for the name HAL?

Arthur C. Clarke: It wasn't mine! It was Stanley's! Originally it was called Athena; we were going to have a woman's name, a woman's voice. Don't ask me when he changed it to HAL. I've been apologizing to all my Harold friends ever since.

Who, among today's visionaries, comes closest to being HAL's "parents"?

Well, actually, Negroponte, who was here the other day, and of course Marvin Minsky, who I met back in the *2001* days. They're still the best-known people in the field, apart from the people out there making hardware.

What will it take for you to concede that a machine has consciousness?

There's an enormous amount of discussion about that now; there's even a society formed to discuss consciousness. Endless books on it: *Consciousness Explained*, *Consciousness Not Explained*, and so on. This is one of the themes in *3001*, incidentally. The monolith turns out not to be conscious.

Anyhow, it's one of the big philosophical problems. Why do we need consciousness? Is it really there, or do we only imagine we're conscious? This way lies madness. I mean, can you prove that you're conscious? To my satisfaction?

Only to my own satisfaction – and even that's doubtful sometimes.

Yes. I'm fond of paraphrasing Descartes: "I think, therefore I am … I think."

Do you suppose a computer could have similar vague doubts about its own consciousness?

Good question. If a computer didn't have doubts, it wouldn't be conscious, probably.

So is there a "Clarke Test" for computer consciousness?

I'll tell you what: if it showed a really genuine sense of humor, then I'd decide it was conscious. That could be a really good test. It would have to be able to make jokes – and make jokes at its own expense.

Anything you would do to re-create HAL if you had the chance?

I have changed it; I've done nothing but that. He's been re-created in every succeeding volume.

Really? How is the HAL in *3001* different from the HAL in *2001*?

Wait and see! You'll learn a lot more about HAL – and Frank Poole – in *3001*. Anyway, there's a lot going on right now; I'm trying to get the trilogy out in one volume. I'm also trying to revive the nonfiction books, which are out of print now: *The Making of Kubrick's 2001* and *The Lost Worlds of 2001*.

When you wrote *2001*, we lived in an era when it seemed anything was possible. What took the wind out of our sails?

Well, Vietnam and Watergate, and, of course, the Cold War – the fact that it's gone. That was the driving force, let's face it. The Cold War was the driving force as far as the Apollo missions were concerned, and they were the highlights.

What will get us back on track to the moon and the planets?

There are two big things now, and I'm pretty confident about one of them: overunity energy devices. These are devices that give out more energy than goes in. Apparently some may be tapping zero point energy – or quantum fluctuations seen at very low temperatures. Some may indeed be cold – or at least low temperature – fusion. These devices are popping up all over the place now; you can search the Web and find the references. There was a recent conference of the cold fusion mafia in Cambridge, Massachusetts. I'll be very surprised if it isn't commercial by 2001.

And that means the end of the fossil fuel age. It also means lightweight energy sources – which is what we need for space travel.

Even more controversial is this announcement about antigravity from Finland. A group of Finnish scientists and engineers claim they've detected a very slight reduction in weight over a spinning superconducting disc, or something like that. It's in the *Journal of Physics D*; they've been peer-reviewed!

It could be 20 or 30 years before anything practical comes out of it, but anything that affects gravity, if it's genuine, is a revolution. It's about the same as Becquerel detecting radioactivity! And the applications appear to be of the same import – if the claim is confirmed.

Where will you be on HAL's birthday?

Probably online, to the University of Illinois; they're doing a Cyberfest. It's HAL's birthday celebration.

You've managed to resist the Web almost completely – true?

Officially, yes; unofficially, no. I've just been overwhelmed with other things. Look, I've got 10 major movie and TV projects on my hands. I'm involved with a quarter of a billion dollars worth of commitments. If a fraction of them actually materialize, I'm a dead man …

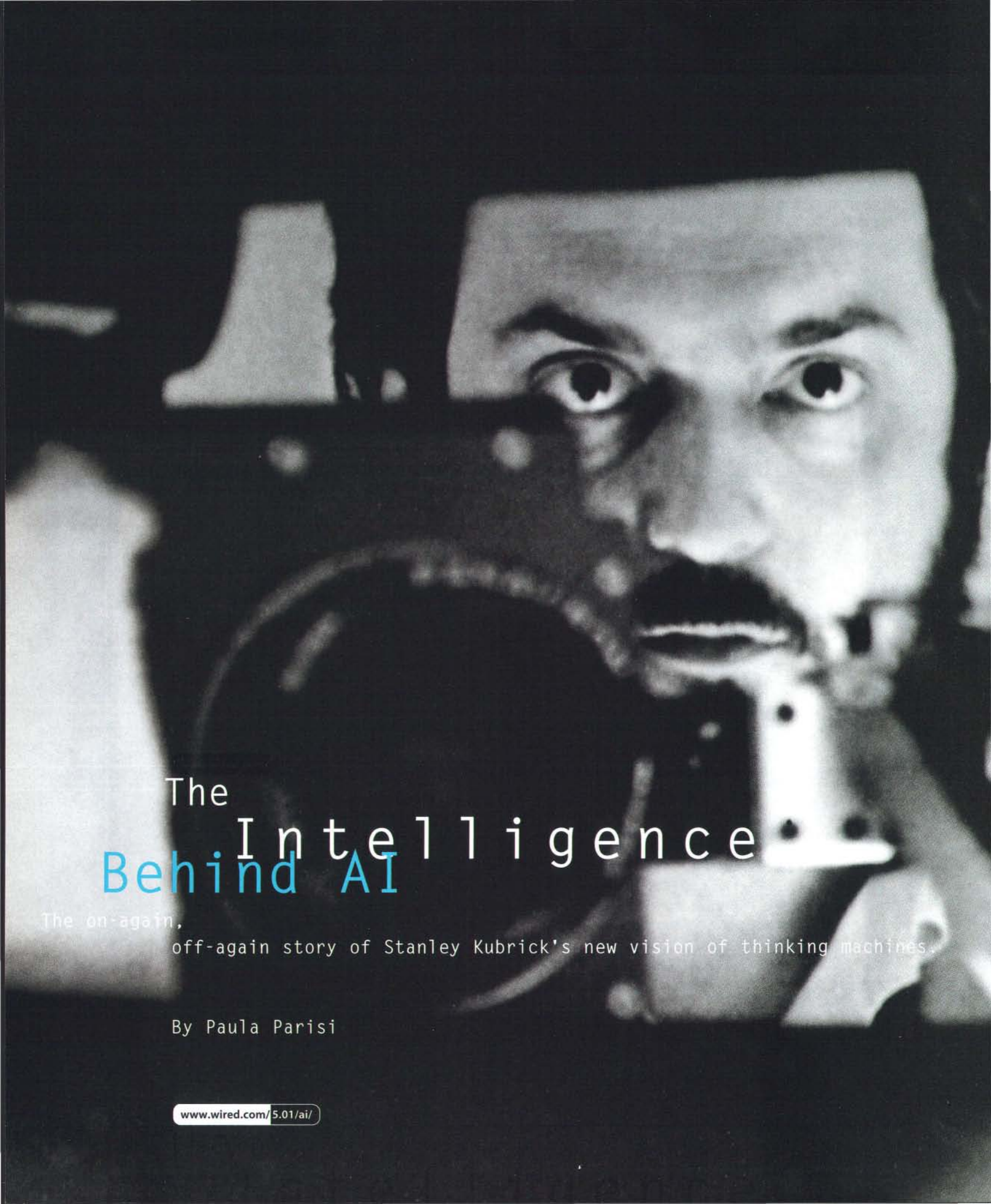
Clarke, if there's one thing I know about you, it's that you're more attracted to fun than money.

Well, that's exactly what I'm doing now. In fact, I did tiptoe onto the Web recently, downloading images of two of Jupiter's moons: Ganymede and Europa.

You'll turn 80 in 1997 – how will you celebrate your birthday?

By starting on my sabbatical decade! Then I'm going to start working on my autobiography. Have I told you the title? *Modest Genius*. And the subtitle? *I Was a Teenage Centenarian*. ■ ■ ■

CLARKE PHOTO: ARCHIVE PHOTOS



The Intelligence Behind AI

The on-again, off-again story of Stanley Kubrick's new vision of thinking machines.

By Paula Parisi

www.wired.com/5.01/ai/

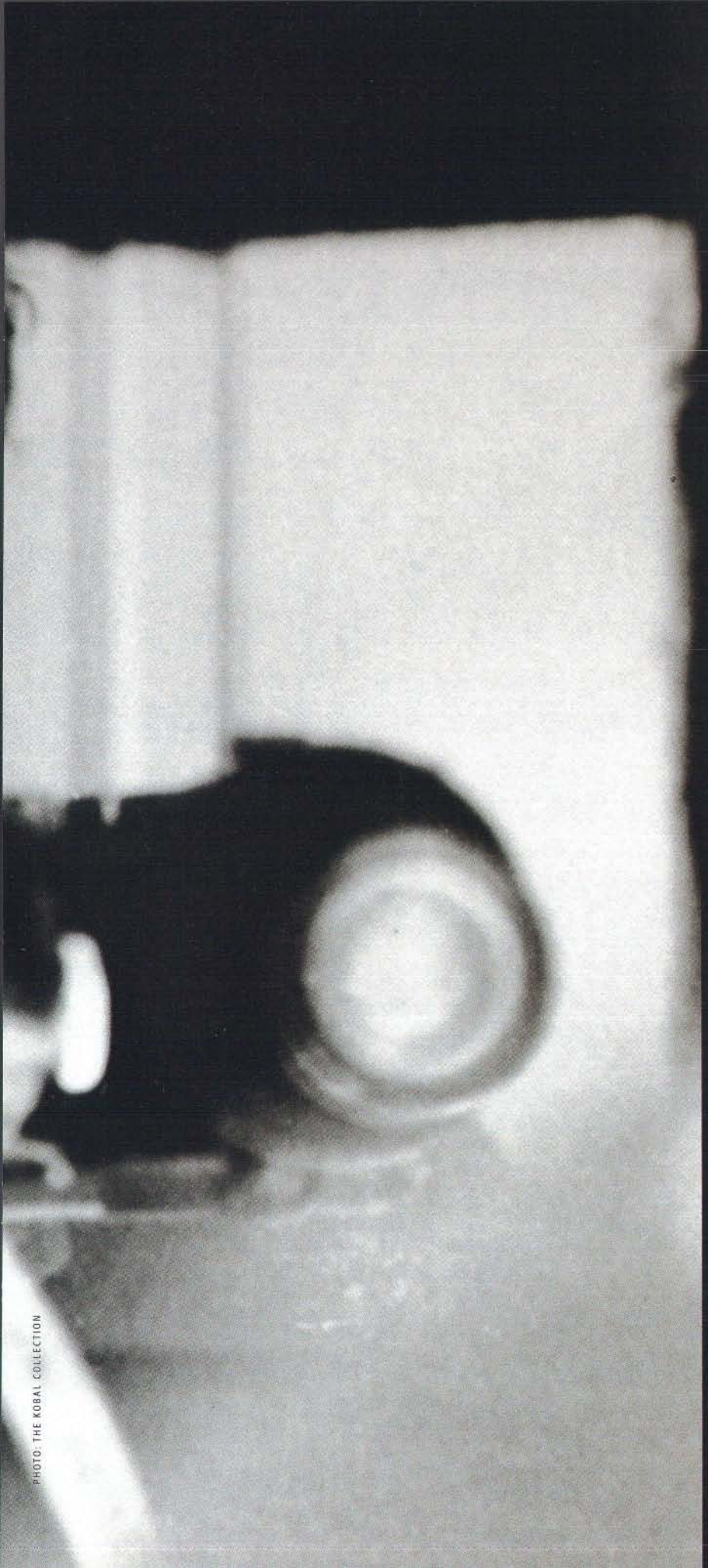


PHOTO: THE KOBAL COLLECTION

Some are born to greatness, others have it thrust upon them, and still others have it programmed into their operating systems. Such was the case with HAL, the iconoclastic digital antagonist of Stanley Kubrick's *2001: A Space Odyssey*. Débuting in a science fiction cinema whose conception of artificial intelligence amounted to clunky chunks of rolling metal like Robby and Gort, the sophisticated, subtly neurotic HAL redefined Hollywood's portrayal of thinking machines. It should surprise no one that Kubrick – who has applied his skills to a variety of material, from pulp to period drama – now appears ready to turn his attention back to the themes of man and automation. True, he's currently directing the conventionally fabulous Tom Cruise and Nicole Kidman in *Eyes Wide Shut*, but it's another, more enigmatic project that has his fans on the Net checking in regularly to alt.movies.kubrick.

For almost a decade, Kubrick has been developing a film project known as *AI* (as in artificial intelligence), which promises to graduate from computers to an android who thinks, is self-aware, and ages. Inspired by "Super-Toys Last All Summer Long," the short story by British author Brian Aldiss (see page 134), *AI* is set in a future when scientists have, as Aldiss writes, "at last found a way to link computer circuitry with synthetic flesh."

"One of the fascinating questions that arises in envisioning computers more intelligent than men is at what point machine intelligence deserves the same consideration as biological intelligence," Kubrick mused in a 1971 interview for the book *Stanley Kubrick Directs*.

"Once a computer learns by experience as well as by its original programming, and once it has access to much more information than any number of human geniuses might possess, the first thing that happens is that you don't really understand it anymore, and you don't know what it's doing or thinking about. You could be tempted to ask yourself in what way is machine intelligence any less sacrosanct than biological intelligence, and it might be difficult to arrive at an answer flattering to biological intelligence."

Kubrick followers will recall that for all the imaginative spark of Arthur C. Clarke's *The Sentinel* – the story that inspired *2001* – it contains no HAL, no Jupiter mission, no enlightened, club-wielding apes. There's no telling how Kubrick's imagination will transform "Super-Toys." Aldiss says that in the early '90s, he and the director made two col- 189 ►

Paula Parisi (73404.720@compuserve.com) *is an editor at* The Hollywood Reporter. *She wrote "Shot by an Outlaw" in* Wired *4.09.*

SEA-DOO

Super-Toys Last All Summer Long

By Brian Aldiss

Image by James Porto

www.wired.com/5.01/supertoys/

Though Brian Aldiss bristles at being pigeonholed as a sci-fi writer, the British author has won every major science fiction award. He has also sparked director Stanley Kubrick's imagination with the short story "Super-Toys Last All Summer Long." First published in *Harper's Bazaar* in 1969 and later anthologized, this tale of humanity in an age of intelligent machines and of the aching loneliness endemic in an overpopulated future is the inspiration behind Kubrick's ongoing *AI* project. Aldiss's story offers richly suggestive details that one hopes will make the cinematic cut. But just in case they don't, read the original.

In Mrs. Swinton's garden, it was always summer. The lovely almond trees stood about it in perpetual leaf. Monica Swinton plucked a saffron-colored rose and showed it to David.

"Isn't it lovely?" she said.

David looked up at her and grinned without replying. Seizing the flower, he ran with it across the lawn and disappeared behind the kennel where the mowervator crouched, ready to cut or sweep or roll when the moment dictated. She stood alone on her impeccable plastic gravel path.

She had tried to love him.

When she made up her mind to follow the boy, she found him in the courtyard floating the rose in his paddling pool. He stood in the pool engrossed, still wearing his sandals.

"David, darling, do you have to be so awful? Come in at once and change your shoes and socks."

He went with her without protest into the house, his dark head bobbing at the level of her waist. At the age of three, he showed no fear of the ultrasonic dryer in the kitchen. But before his mother could reach for a pair of slippers, he wriggled away and was gone into the silence of the house.

He would probably be looking for Teddy.

Monica Swinton, twenty-nine, of graceful shape and lambent eye, went and sat in her living room, arranging her limbs with taste. She began by sitting and thinking; soon she was just sitting. Time waited on her shoulder with the maniac slowth it reserves for children, the insane, and wives whose husbands are away improving the world. Almost by reflex, she reached out and changed the wavelength of her windows. The garden faded; in its place, the city center rose by her left hand, full of crowding people, blowboats, and buildings (but she kept the sound down). She remained alone. An overcrowded world is the ideal place in which to be lonely.

The directors of Synthank were eating an enormous luncheon to celebrate the launching of their new product. Some of them wore the plastic face-masks popular at the time. All were elegantly slender, despite the rich food and drink they were putting away. Their wives were elegantly slender, despite the food and drink they too were putting away. An earlier and less sophisticated generation would have regarded them as beautiful people, apart from their eyes.

Henry Swinton, Managing Director of Synthank, was about to make a speech.

"I'm sorry your wife couldn't be with us to hear you," his neighbor said.

"Monica prefers to stay at home thinking beautiful thoughts," said Swinton, maintaining a smile.

"One would expect such a beautiful woman to have beautiful thoughts," said the neighbor.

Take your mind off my wife, you bastard, thought Swinton, still smiling.

He rose to make his speech amid applause.

After a couple of jokes, he said, "Today marks a real breakthrough for the company. It is now almost ten years since we put our first synthetic life-forms on the world market. You all know what a success they have been, particularly the miniature dinosaurs. But none of them had intelligence.

"It seems like a paradox that in this day and age we can create life but not intelligence. Our first selling line, the Crosswell Tape, sells best of all, and is the most stupid of all." Everyone laughed.

"Though three-quarters of the overcrowded world are starving, we are lucky here to have more than enough, thanks to population control. Obesity's our problem, not malnutrition. I guess there's nobody round this table who doesn't have a Crosswell working for him in the small intestine, a perfectly safe parasite tape-worm that enables its host to eat up to fifty percent more food and still keep his or her figure. Right?" General nods of agreement.

"Our miniature dinosaurs are almost equally stupid. Today, we launch an intelligent synthetic life-form – a full-size serving-man.

"Not only does he have intelligence, he has a controlled amount of intelligence. We believe people would be afraid of a being with a human brain. Our serving-man has a small computer in his cranium.

"There have been mechanicals on the market with minicomputers for brains – plastic things without life, super-toys – but we have at last found a way to link computer circuitry with synthetic flesh."

David sat by the long window of his nursery, wrestling with paper and pencil. Finally, he stopped writing and began to roll the pencil up and down the slope of the desk-lid.

"Teddy!" he said.

Teddy lay on the bed against the wall, under a book with moving pictures and a giant plastic soldier. The speech-pattern of his master's voice activated him and he sat up.

"Teddy, I can't think what to say!"

Climbing off the bed, the bear walked stiffly over to cling to the boy's leg. David lifted him and set him on the desk.

"What have you said so far?"

"I've said –" He picked up his letter and stared hard at it. "I've said, 'Dear Mummy, I hope you're well just now. I love you....'"

There was a long silence, until the bear said, "That sounds fine. Go downstairs and give it to her."

Another long silence.

"It isn't quite right. She won't understand."

Inside the bear, a small computer worked through its program of possibilities. "Why not do it again in crayon?"

When David did not answer, the bear repeated his suggestion. "Why not do it again in crayon?"

Monica Swinton sat in her living room. Almost by reflex, she reached out and changed the the city center rose, full of crowding people, blowboats, and buildings.

Reprinted with permission of the author. Copyright 1969.

David was staring out of the window. "Teddy, you know what I was thinking? How do you tell what are real things from what aren't real things?"

The bear shuffled its alternatives. "Real things are good."

"I wonder if time is good. I don't think Mummy likes time very much. The other day, lots of days ago, she said that time went by her. Is time real, Teddy?"

"Clocks tell the time. Clocks are real. Mummy has clocks so she must like them. She has a clock on her wrist next to her dial."

David started to draw a jumbo jet on the back of his letter. "You and I are real, Teddy, aren't we?"

The bear's eyes regarded the boy unflinchingly. "You and I are real, David." It specialized in comfort.

Monica walked slowly about the house. It was almost time for the afternoon post to come over the wire. She punched the Post Office number on the dial on her wrist but nothing came through. A few minutes more.

She could take up her painting. Or she could dial her friends. Or she could wait till Henry came home. Or she could go up and play with David....

She walked out into the hall and to the bottom of the stairs.

"David!"

No answer. She called again and a third time.

"Teddy!" she called, in sharper tones.

"Yes, Mummy!" After a moment's pause, Teddy's head of golden fur appeared at the top of the stairs.

"Is David in his room, Teddy?"

"David went into the garden, Mummy."

"Come down here, Teddy!"

She stood impassively, watching the little furry figure as it climbed down from step to step on its stubby limbs. When it reached the bottom, she picked it up and carried it into the living room. It lay unmoving in her arms, staring up at her. She could feel just the slightest vibration from its motor.

"Stand there, Teddy. I want to talk to you." She set him down on a tabletop, and he stood as she requested, arms set forward and open in the eternal gesture of embrace.

"Teddy, did David tell you to tell me he had gone into the garden?"

The circuits of the bear's brain were too simple for artifice. "Yes, Mummy."

"So you lied to me."

"Yes, Mummy."

"Stop calling me Mummy! Why is David avoiding me? He's not afraid of me, is he?"

"No. He loves you."

"Why can't we communicate?"

"David's upstairs."

The answer stopped her dead. Why waste time talking to this machine? Why not simply go upstairs and scoop David into her arms and talk to him, as a loving mother should to a loving son? She heard the sheer weight of silence in the house, with a different quality of silence pouring out of every room. On the upper landing, something was moving very silently – David, trying to hide away from her....

He was nearing the end of his speech now. The guests were attentive; so was the Press, lining two walls of the banqueting chamber, recording Henry's words and occasionally photographing him.

"Our serving-man will be, in many senses, a product of the computer. Without computers, we could never have worked through the sophisticated biochemics that go into synthetic flesh. The serving-man will also be an extension of the computer – for he will contain a computer in his own head, a microminiaturized computer capable of dealing with almost any situation he may encounter in the home. With reservations, of course." Laughter at this; many of those present knew the heated debate that had engulfed the Synthank boardroom before the decision had finally been taken to leave the serving-man neuter under his flawless uniform.

"Amid all the triumphs of our civilization – yes, and amid the crushing problems of overpopulation too – it is sad to reflect how many millions of people suffer from increasing loneliness and isolation. Our serving-man will be a boon to them; he will always answer, and the most vapid conversation cannot bore him.

"For the future, we plan more models, male and female – some of them without the limitations of this first one, I promise you! – of more advanced design, true bio-electronic beings.

"Not only will they possess their own computer, capable of individual programming; they will be linked to the World Data Network. Thus everyone will be able to enjoy the equivalent of an Einstein in their own homes. Personal isolation will then be banished forever!"

He sat down to enthusiastic applause. Even the synthetic serving-man, sitting at the table dressed in an unostentatious suit, applauded with gusto.

Dragging his satchel, David crept round the side of the house. He climbed on to the ornamental seat under the living-room window and peeped cautiously in.

His mother stood in the middle of the room. Her face was blank; its lack of expression scared him. He watched fascinated. He did not move; she did not move. Time might have stopped, as it had stopped in the garden.

At last she turned and left the room. After waiting a moment, David tapped on the window. Teddy looked round, saw him, tumbled off the table, and came over to the window. Fumbling with his paws, he eventually got it open.

They looked at each other.

"I'm no good, Teddy. Let's run away!"

"You're a very good boy. Your Mummy loves you."

Slowly, he shook his head. "If she loved me, then why can't I talk to her?"

"You're being silly, David. Mummy's lonely. That's why she had you."

wavelength of her windows. The garden faded; in its place,

She remained alone. An overcrowded world is the ideal place in which to be lonely.

"She's got Daddy. I've got nobody 'cept you, and I'm lonely."

Teddy gave him a friendly cuff over the head. "If you feel so bad, you'd better go to the psychiatrist again."

"I hate that old psychiatrist – he makes me feel I'm not real." He started to run across the lawn. The bear toppled out of the window and followed as fast as its stubby legs would allow.

Monica Swinton was up in the nursery. She called to her son once and then stood there, undecided. All was silent.

Crayons lay on his desk. Obeying a sudden impulse, she went over to the desk and opened it. Dozens of pieces of paper lay inside. Many of them were written in crayon in David's clumsy writing, with each letter picked out in a color different from the letter preceding it. None of the messages was finished.

"My dear Mummy, How are you really, do you love me as much –"

"Dear Mummy, I love you and Daddy and the sun is shining –"

"Dear dear Mummy, Teddy's helping me write to you. I love you and Teddy –"

"Darling Mummy, I'm your one and only son and I love you so much that some times –"

"Dear Mummy, you're really my Mummy and I hate Teddy –"

"Darling Mummy, guess how much I love –"

"Dear Mummy, I'm your little boy not Teddy and I love you but Teddy –"

"Dear Mummy, this is a letter to you just to say how much how ever so much –"

Monica dropped the pieces of paper and burst out crying. In their gay inaccurate colors, the letters fanned out and settled on the floor.

Henry Swinton caught the express home in high spirits, and occasionally said a word to the synthetic serving-man he was taking home with him. The serving-man answered politely and punctually, although his answers were not always entirely relevant by human standards.

The Swintons lived in one of the ritziest city-blocks, half a kilometer above the ground. Embedded in other apartments, their apartment had no windows to the outside; nobody wanted to see the overcrowded external world. Henry unlocked the door with his retina pattern-scanner and walked in, followed by the serving-man.

At once, Henry was surrounded by the friendly illusion of gardens set in eternal summer. It was amazing what Whologram could do to create huge mirages in small spaces. Behind its roses and wisteria stood their house; the deception was complete: a Georgian mansion appeared to welcome him.

"How do you like it?" he asked the serving-man.

"Roses occasionally suffer from black spot."

"These roses are guaranteed free from any imperfections."

"It is always advisable to purchase goods with guarantees, even if they cost slightly more."

"Thanks for the information," Henry said dryly. Synthetic lifeforms were less than ten years old, the old android mechanicals less than sixteen; the faults of their systems were still being ironed out, year by year.

He opened the door and called to Monica.

She came out of the sitting-room immediately and flung her arms round him, kissing him ardently on cheek and lips. Henry was amazed.

Pulling back to look at her face, he saw how she seemed to generate light and beauty. It was months since he had seen her so excited. Instinctively, he clasped her tighter.

"Darling, what's happened?"

"Henry, Henry – oh, my darling, I was in despair ... but I've just dialed the afternoon post and – you'll never believe it! Oh, it's wonderful!"

"For heaven's sake, woman, what's wonderful?"

He caught a glimpse of the heading on the photostat in her hand, still moist from the wall-receiver: Ministry of Population. He felt the color drain from his face in sudden shock and hope.

"Monica ... oh ... Don't tell me our number's come up!"

"Yes, my darling, yes, we've won this week's parenthood lottery! We can go ahead and conceive a child at once!"

He let out a yell of joy. They danced round the room. Pressure of population was such that reproduction had to be strict, controlled. Childbirth required government permission. For this moment, they had waited four years. Incoherently they cried their delight.

They paused at last, gasping, and stood in the middle of the room to laugh at each other's happiness. When she had come down from the nursery, Monica had de-opaqued the windows, so that they now revealed the vista of garden beyond. Artificial sunlight was growing long and golden across the lawn – and David and Teddy were staring through the window at them.

Seeing their faces, Henry and his wife grew serious.

"What do we do about them?" Henry asked.

"Teddy's no trouble. He works well."

"Is David malfunctioning?"

"His verbal communication-center is still giving trouble. I think he'll have to go back to the factory again."

"Okay. We'll see how he does before the baby's born. Which reminds me – I have a surprise for you: help just when help is needed! Come into the hall and see what I've got."

As the two adults disappeared from the room, boy and bear sat down beneath the standard roses.

"Teddy – I suppose Mummy and Daddy are real, aren't they?"

Teddy said, "You ask such silly questions, David. Nobody knows what 'real' really means. Let's go indoors."

"First I'm going to have another rose!" Plucking a bright pink flower, he carried it with him into the house. It could lie on the pillow as he went to sleep. Its beauty and softness reminded him of Mummy. ■ ■ ■

"Teddy – I suppose Mummy and Daddy are real, aren't they?" David asked.

"You ask such silly questions, David," Teddy said. "Nobody knows what 'real' really means."

ON THE TRAIL OF SETI!

SCIENTISTS TAP INTO COSMIC INTERNET!

Scientific Study Targets 6,000 Stars!

Martian microbes found in Antarctica!

POPULAR CULTURE AWASH IN ALIENS!

ZILLIONAIRES IMPLICATED!

FOLLOW THE MONEY:

- William Hewlett!
- David Packard!
- Paul Allen!
- Arthur C. Clarke!
- Gordon Moore!

PHYSICISTS BUILD GALACTIC HAM RADIO!

Astronomers detect religious broadcast – from Mars!

TELESCOPE AND UFO IMAGES: SETH SHOSTAK; ALIENS (FROM LEFT): USA NETWORK/MPTV; UNIVERSAL PICTURES/MPTV; EVERETT COLLECTION; MOVIE STILL ARCHIVES: CLARKE: DANA FINEMAN/SYGMA; ALLEN: KAREN MOSKOWITZ/OUTLINE

THE TRUTH THAT NASA

SETI's "archeology of the future" key to cracking cosmic silence.

Nearly 12 years ago, in the spring of 1985, I found myself the only reporter at a small astronomical conference in Green Bank, West Virginia, home of the National Radio Astronomy Observatory.

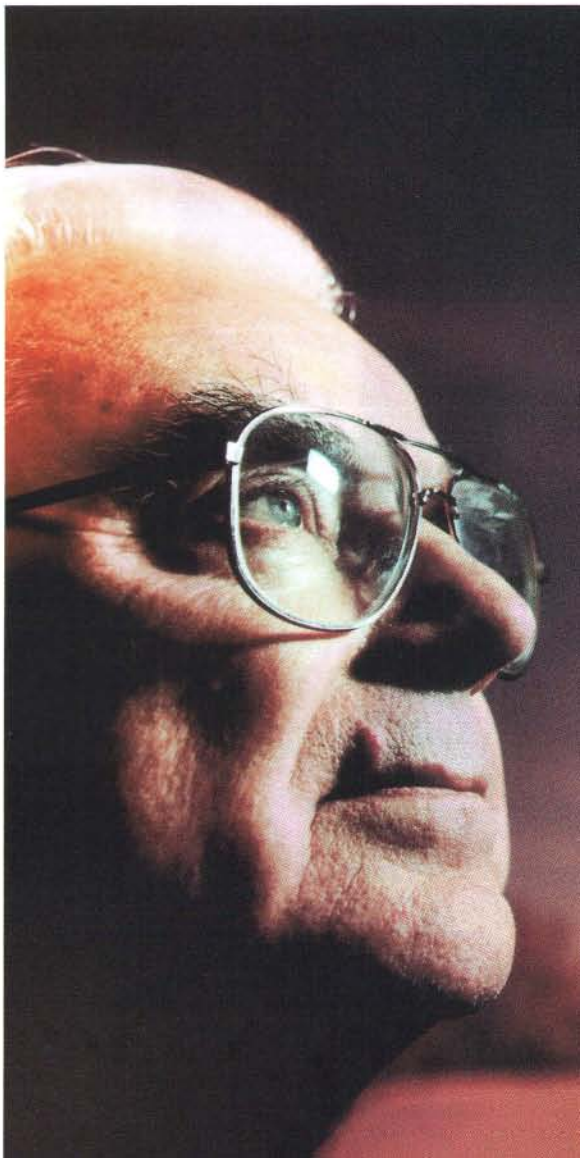
As is customary at such events, there was a banquet – in this case an outdoor barbecue of the kind you can only dream about outside the South. The assembled astronomers had barely filled their plates and sat down when, to my amazement, they burst into song. To the tune of the Wisconsin fight song, they began singing, "*Down* with Proxmire, *down* with Proxmire ..." softly at first, and then more and more ebulliently.

William Proxmire, a Democrat from Wisconsin, is long gone from the United States Senate, but his spirit lives on. During his lengthy career, the otherwise liberal Proxmire was an outspoken opponent of government waste, famous for the "Golden Fleece" awards he bestowed on what he considered particularly egregious sins against the taxpayers. One of his favorite targets was a NASA proposal to research methods of using large radio telescopes in a systematic search for radio signals from extraterrestrial civilizations. Of course, the singing astronomers gathered around the picnic tables in Green Bank that day were the originators and pioneers of that idea, known as SETI – the Search for Extraterrestrial Intelligence. It had been 25 years since a young, wavy-haired Cornell astronomer named Frank Drake first pointed a radio telescope at a pair of nearby stars and listened for a signal. For most of their adult lives, Proxmire had almost single-handedly prevented these astronomers from carrying out their mission.

My thoughts flashed back to that barbecue while watching NASA scientists announce last August that the remains of Martian microbes might have been discovered in an Antarctic meteorite. The odds for life beyond Earth have never looked so good. In the last year, astronomers, after decades of fruitless search, have begun discovering giant planets orbiting other stars. NASA geologists have concluded that there is a good chance of finding liquid water on Jupiter's moon Europa. Biologists have succeeded in decoding the genes of an organism found in broiling undersea vents and concluded that it belongs to a primitive, previously unrecognized branch of life on Earth – one that might be perfectly at home in a Martian rock or at the bottom of a

By Dennis Overbye

www.wired.com/5.01/seti/



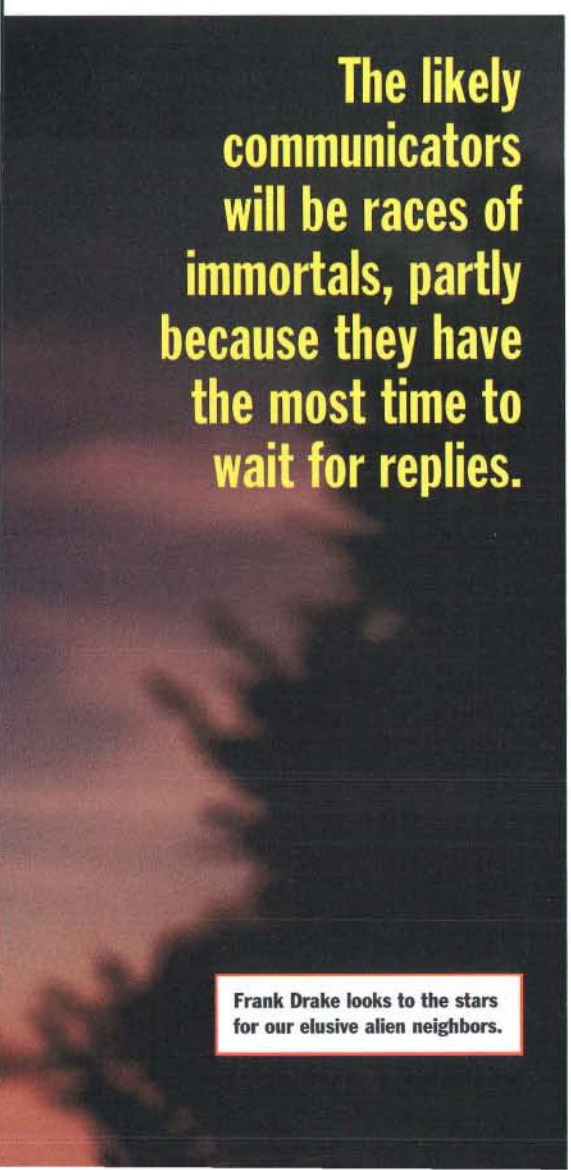
DARES NOT SPEAK!

FRANK DRAKE: WILLIAM MERCER MCLEOD; TELESCOPE: SETH SHOSTAK

Europan ocean. As part of the much ballyhooed Origins program – intended to reenergize the beleaguered and bureaucratic space agency – NASA has been studying plans for spacecraft observatories that could detect and study Earthlike planets, so-called pale blue dots, around other stars.

Meanwhile, popular culture is awash in aliens. You can't turn on the television without running into a clone of *The X-Files*. According to a Scripps Howard/Ohio University survey, half the American population believes that the government has been hiding the truth about the existence of UFOs. Accounts of alien abductions have become as stylized as Kabuki drama. In September, three separate art galleries in downtown Manhattan opened shows devoted to extraterrestrials and UFOs. The only people not invited to the alien celebration, it seems, are the SETI astronomers themselves.

The likely communicators will be races of immortals, partly because they have the most time to wait for replies.



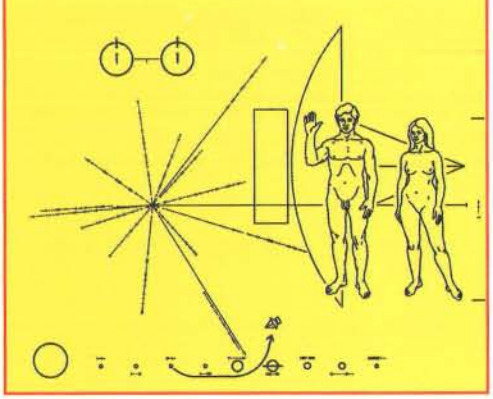
Frank Drake looks to the stars for our elusive alien neighbors.

The rationale for searching the skies was laid out by physicists Philip Morrison and Giuseppe Cocconi in a *Nature* article back in 1959, a year before Drake pointed his telescope. The logic is pretty simple: Interstellar space travel based on any foreseeable physics would be expensive and inconvenient, with trip times far exceeding the human life span; radio waves, on the other hand, are cheap. A reasonably intelligent civilization, the argument goes, would soon come to the same realization that the best way to contact potential neighbors would be to set out giant radio beacons and engage in a kind of galactic ham radio. If any such civilizations exist Out There – and thoughtful people have put forward carefully reasoned estimates ranging from millions to none – a suitably tuned radio telescope aimed at the right part of the sky might tap into a sort of cosmic internet. Interstellar distances being vast, communication – even at the speed of light – would likely take the form of one-way messages, although the optimistic Drake once argued in an article in *Technology Review* that the likely communicators would be races of immortals, partly because they had the most time to wait for replies. Other times he has joked that the most common form of signal would be religious broadcasts.

For a kid raised on the stories of Arthur C. Clarke, meeting the SETI crew was like a science fiction romance come to life. At one of their conferences you were likely to hear talks about interstellar engineering or migration patterns in the South Pacific, as well as about radio astronomy and signal-detection algorithms. If radio technology was the entrance requirement to the galactic club, the story went, 190 ►

SETI's greatest hope – the radio telescope in West Virginia.

The *Pioneer 10* spacecraft, the first man-made object to escape our solar system, carried this plaque – NASA's bare-bones attempt at symbolic intergalactic communication.



Dennis Overbye is the author of Lonely Hearts of the Cosmos: The Scientific Quest for the Secret of the Universe. *He is currently writing a book about Albert Einstein.*

CONFESSIONS OF A WEBBACK

Guillermo Gómez-Peña uses the anonymous, open nature of the Net to turn racism into art.

By Evantheia Schibsted

Chicano performance artist Guillermo Gómez-Peña likes to cross borders, both real and virtual. As an explorer of US-Mexico relations he has uncovered a volatile new demarcation line: the Internet. Gómez-Peña surveys cultural stereotypes from information gathered on a confessional Web site *(www.echonyc.com/~temple/)*. The San Francisco artist then teams with Roberto Sifuentes to stylize the data into bizarre *Ethnocyborgs*, like the Mex-Terminator and CyberVato, who reflect the best and worst of racial preconceptions.

Wired: You call yourself a "reverse anthropologist." Why?

Gómez-Peña: In the late '80s, many artists of color reversed the epistemological premise of "I'll perform for you so you'll understand and accept me and my culture." Instead we treat the dominant culture as if it's exotic and unfamiliar. I observe cultural behavior and create art that articulates America to itself.

How does your Web site facilitate this?

In the past, we gathered opinions on racial stereotypes and immigration from visitors to our performance spaces. But on the Net you have *total* anonymity. You can hide your gender, race, social class, accent. So many of these online confessions are more outrageous, and more performative. People give opinions on what kind of clothes they want us to wear, what music we should listen to, what spiritual, sexual, and political behavior we should engage in. Or someone may confess a crime, such as having killed a migrant worker. Even if that confession is false, the desire is revealing and culturally significant.

Doesn't that make you skeptical of the responses you receive?

People reveal a lot even by choosing a fictional identity or creating a fictitious literary narrative. Our job as artists is to unleash these colonial demons – to open Pandora's box. It's not to moralize.

Is there something about the Net's anonymity that allows people to get in touch with their dark side?

There are no repercussions. People can be crass, obscene, hurtful, as well as sincere and intimate. My guess is that many are people who, in public, would be very well-behaved and culturally sensitive. But once you create the conditions to say what they *really* feel, they go for it.

More honest?

Yes. There's no political correctness whatsoever. But not all Web responses are negative. The Ethnocyborgs are composites based on a multiplicity of fears and desires. They can be friendly, open, and as attractive as they are appalling. The CyberVato, for instance, is a pre-industrial shaman, a bohemian. He's highly sexual and exotic.

What does your work say about human nature?

America is living with an incredible paradox. It's the most multicultural society on earth – that is its utopian strength – but it's also riddled with fear of otherness and change. I want to make that visible through the creation of these Ethnocyborgs. Hopefully people will see their own inner savages – which are in all of us – and deal with them. We're saying, Hey, we're not that different.

But why do you think these online responses reflect the views of Americans? This is an anonymous survey, and the Net is an international network.

Cultural references. When someone expresses fear of Mexicans invading their neighborhood, the person is clearly not in Paris. Or they mention specific anti-immigration legislation. Maybe they say "where I live in LA" or "here in Arizona." But fear of immigration is not limited to the US. It's international. Germans talk about Turks. Italians fear Albanians. In the US, there's Mexiphobia.

How have perceptions of Mexicans changed?

In the '80s, Mexicans were depicted as extremely passive – the lazy Mexican sleeping by a cactus wearing a sombrero, the Frito Bandito. Not capable of carrying out real violence. No political agenda. But the anti-immigrant political rhetoric portrays Mexicans as invaders. Mexico is seen as filled with corrupt politicians, drug dealers, terrorists. That's reflected in the Mex-Terminator. He intends to invade the North, redefine the West, reconquer this land, recoup the Southwest for Mexico. He's also violent and indiscriminately kills cops and border patrol officers.

You call yourself a "Webback." Do you see yourself as an intruder on the Net?

Yes. The number of Latino students, artists, and activists on the Net is minute. But we want to participate in the national and cultural debates, and many are permeated by technology. I consider myself a *coyote*, a smuggler of ideas. We want Net inhabitants to get used to a new cultural sensibility. But we do encounter the linguistic border patrol.

How so?

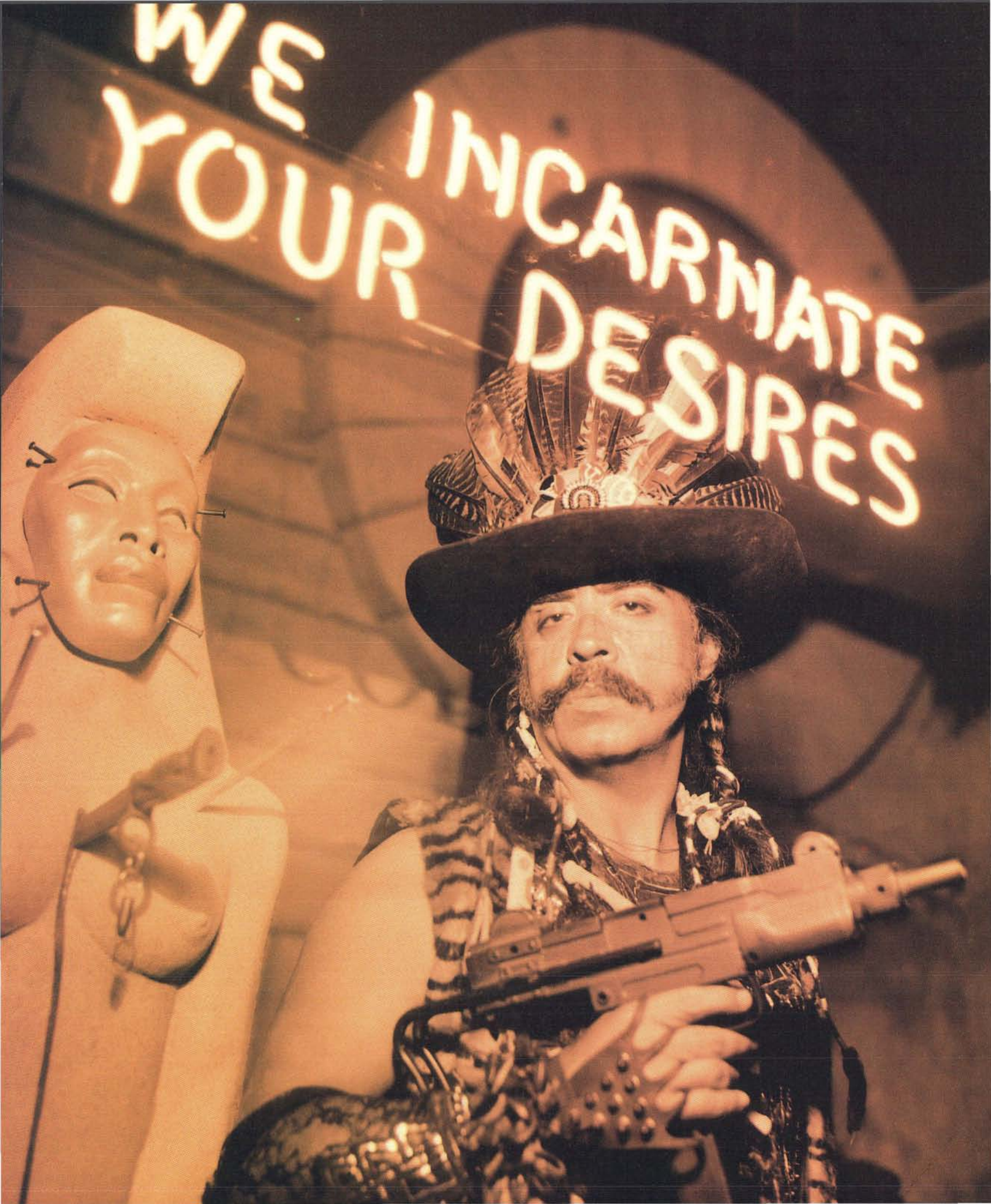
There's a linguistic hegemony because of the way debates are framed and the fact that English is the lingua franca. We often send *technoplacas*, which are basically just humorous Spanglish texts questioning matters of access, privilege, and power relative to the Net. We often receive responses such as, "Go back to your cyber barrio."

In the coming century, do you think culture will be defined by access to technology?

It's already happening. We're witnessing the creation of nations that are not defined by territory, culture, race, or language. They will be defined by the Internet. As Latinos, we don't want to be left behind. ■ ■ ■

Evantheia Schibsted (evantheias@aol.com) *is a San Francisco Bay area writer.*

PHOTO: KLAUS SCHONWEISE


WE INCARNATE
YOUR DESIRES

CELLULAR OBSESSION

What happens when you cut cellular rates to pennies and let any kid have a stripped-down mobile phone? With the lowest rates on the planet, Israel is the world's cellular petri dish. A lot of weird life-forms are sprouting up.

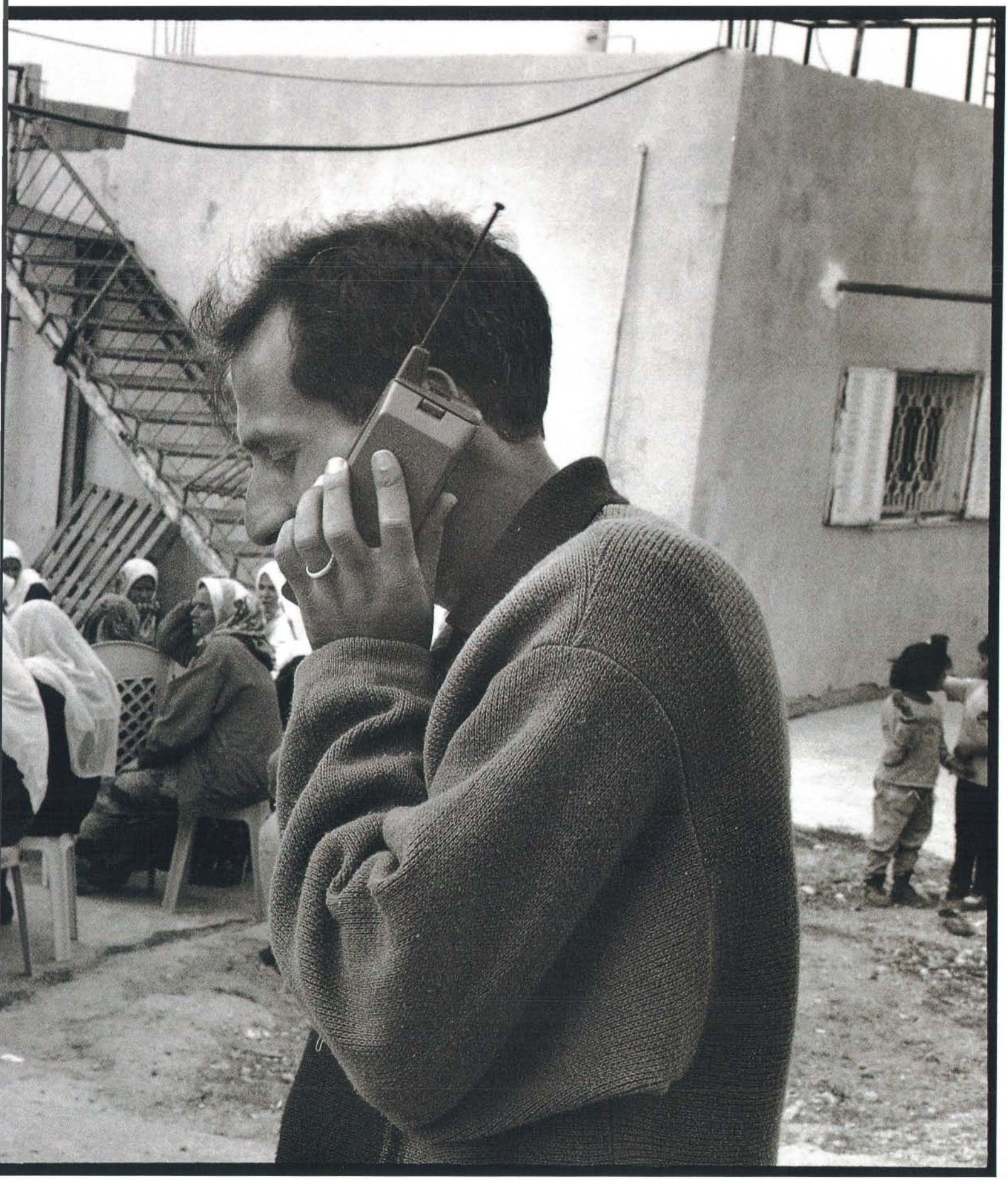
By Sheldon Teitelbaum
Photographs By Gilles Peress

www.wired.com/5.01/israeliphone/

Strolling through a mall in the heart of fashionable Tel Aviv, where a Hamas terrorist recently blew himself up next to an ATM, and where Israeli youngsters bungee-jump in air-conditioned comfort – I occasioned upon a real Israeli novelty: a spanking clean men's room.

Inside, I saw a man urinating into a shiny porcelain receptacle, his fingers occupied with matters at hand. But crooked between his shoulder and ear was a cellular telephone. The fellow was taking a whiz while instructing Shula, his secretary, which bills to pay now and which to leave for later. Not wishing to interrupt, I headed for a stall. Soon someone entered the one next to mine and began talking. I assumed he must be speaking to me and wondered at this latest intrusion of personal space, which seemed gauche even by local standards. I quickly understood, however, that he was making an appointment with his dentist.

Suddenly, it dawned on me why Israeli newspapers kept writing about a rabbinical ruling forbidding Jews to converse with others while engaged



in elimination. This prohibition was well known among Orthodox Jews: the faithful may not answer anyone – even a family member – who calls while they are thus engaged. Apparently, the rabbis felt a renewed need to educate consumers not only in the rudiments of Jewish law, but also in the appropriate use of cell phones. Israelis, having succumbed to cellular mania, simply have no concept of downtime anymore. The three-hour afternoon siestas and leisurely work habits of yesteryear have been largely relegated to mythic memory. So, it turns out, has the leisurely dump.

I soon found myself ceding the rabbis their point. A brief jaunt almost anyplace in Israel these days reveals that the Jewish state is chock-full of cell phones. People carry them everywhere: to the beach, the desert, the corner store, even to pray at the Wailing Wall. Even kids are wired with low-end cell phones, called Mangos, that can receive, but not send, most calls.

In an impossibly short time, tiny Israel has emerged as a cellular superpower, easily beating out telecommunications "backwaters" such as Great Britain, France, and Germany in the number of cell phones in use per capita.

The Great Flood began in December 1994, when an Israeli cellular start-up called Cellcom (a consortium made up of BellSouth International, the Israel Development Bank, and the Safra banking group) announced the lowest airtime rates anywhere on the planet: two-and-a-half cents for a full minute of blab any time of the day.

Thanks largely to digitalization, Israeli cell phones instantaneously became cheaper – for all but a few kinds of calls – than ordinary land lines, with 300 minutes selling for less than US$8, not the $136 they'd cost in the US. In response, Israelis began using their cellular phones in their own living rooms and beds, not to mention their cars, bunkers, and bathrooms.

In the two years since Cellcom's launch, the cellular phone, or "pelephone," as it is referred to generically, has replaced the automatic rifle as the device whose ubiquity now most astonishes Western visitors. From a base of perhaps 70,000 users only two years ago, 900,000 Israelis (out of a total population of 5.7 million) now subscribe to cellular telephone services, according to Cellcom CEO Ya'akov Peri. They sign up with either Cellcom or its analog-based arch rival, Pele-Phone Communications, a subsidiary of Bezeq and Motorola Israel Ltd. that caters to more than 300,000 high-end business users, most of whom remain convinced that digital cellular service is entirely substandard.

In an impossibly short time, tiny Israel has emerged as a cellular superpower. Oren Most, Cellcom's VP for marketing and sales, says Israel easily beats out telecommunications "backwaters" such as Great Britain, France, and Germany in the number of cell phones in use per capita and surpasses virtually every other country in the world in the speed of cell phone penetration. The overall growth rate for cellular telephone use in Israel is now gauged at 250 percent per annum.

This wireless boom has occurred, not incidentally, in tandem with a dramatic increase in Israeli computer ownership and connectivity. A survey conducted by the Hebrew daily *Ma'ariv* in October 1996 found that 44 percent of Israel's 1.45 million households now own a personal computer, rendering the nation one of the most computerized societies anywhere. The Jewish sector in Israel boasts 47 percent PC penetration, while the Arab sector, with 24 percent, surpasses some European countries.

More than 100,000 Israeli families, meanwhile, have already found their way onto the Net, reports the *Ma'ariv* survey. Part of the Israelis' attraction to the Net may be that after half a century of embattled existence in a politically ostracized sliver of a country, they have suddenly found lebensraum in a wide-open, borderless,

largely cosmopolitan venue.

One reason for Israel's cellular *kwisatz haderach* (to use Frank Herbert's Hebraization of the term *quantum leap* in *Dune*) is that Israel already was one of the world's most wired countries – if not in the technical sense, then in the human sense. True, in the aftermath of the 1967 Six-Day War, Israel boasted only one television station broadcasting a few hours a day, a few tired radio stations, and a wait for a standard house phone that averaged three years or more. But in that same Israel, two or three – not six – degrees of separation existed between most people, and everyone who mattered or knew someone who did was tied, one way or another, into a surprisingly accurate and comprehensive information nexus.

Into that fertile soil, former Communications Minister Shulamit Aloni in 1991 planted the idea of putting a cellular phone into the back pocket of every Israeli. To encourage cheap access to cellular airtime, the Israeli government eschewed the steep licensing fees generally required of newcomers to national markets, offering free radio spectrum to the company that came up with the winning bid. The victor was not required to pony up money but to provide as many users with the greatest (read: cheapest) telecommunications benefit in the shortest possible time.

"The idea," says David Gordon, computer and communications editor of *Ma'ariv*, "was to help the consumer. If you look at other countries, you find that the license fees flow directly into the government's coffers. In Israel, the government took an unusually enlightened approach."

To sustain its low rates, Cellcom required a mass market – no mean feat in a cramped, spectrum-poor country where the military traditionally has hogged the airwaves. To create that market, it adopted a highly efficient digital cellular standard, time-division multiple access (TDMA), a technology adopted by most digital providers in the US. However, Europe, the Arab world, and the Palestinian Authority use groupe speciale mobile (GSM), a standard so similar to TDMA that it's not worth worrying about the differences – with one exception. Using either one, you can't place or receive calls across big urban areas or countries that use the other standard.

TDMA is reminiscent of the time-sharing methods used by minicomputers and mainframes to permit access to large numbers of users. Cellcom uses time-division multiplexing, designed to squeeze close to four times the capacity out of a single frequency. Later upgrades are expected to offer six to eight times the capacity. Another standard, code-division multiple access (CDMA), offers up to 20 times the capacity and is meant to be more secure from eavesdropping. Several US providers are considering adopting it, but the technology has not yet been proven with real users out in the field.

Quite apart from the technical difficulties inherent in squeezing a large volume of chatter into a thin wedge of spectrum, Cellcom faced a general reluctance by Israeli subscribers to pay for unsolicited calls and faxes. To combat this fear of freeloading, it opted for an innovative billing scheme called CPP, "calling party pays." In short, this shifts the cost from the receiver of the call to the person calling – a complete paradigm shift from the system used throughout the US.

This system, coupled with cheap user rates, may have put Israel over the top in wireless expansionism. With costly nuisance calls eliminated, subscribers could hand out their numbers freely. Many have since placed their cellular numbers on business cards. Others have posted them in newspaper ads. Some have dispensed with their home phones entirely.

In today's tech-happy Jewish state, the rapturous response to Cellcom's offer of dirt-cheap airtime in late 1994 should have been foreseen. But the breakneck speed with which Israelis jumped on board took nearly everyone, including Cellcom, by surprise.

Right from the start, Israelis began queuing up at Cellcom offices in droves. Their desperation was fueled by the fact that cell phones are, for most Israelis, tax deductible. Israelis are died-in-the-wool *halturists* – moonlighters. Virtually everyone, from the lowest schwarma hawker to the highest-ranking CEO, can justify a cell phone purchase to the country's otherwise draconian *Maas Hachnassa*, or Tax Authority. It was no accident, therefore, that Cellcom launched on December 27, a few days before the end of the tax year. Some prospective customers even took the unusual step of beating the tar out of queue jumpers to secure their place in line. This violence, it must be noted, grew out of an elemental Israeli compulsion to reach out and touch someone.

Israel now occupies second place in the world for the number of phone calls of all types – both cellular and regular – placed per resident, according to the International Communications Association. (First place goes to the US.) The typical Israeli places 1,100 calls a year, compared with 644 for a German, and 591 for an Italian. In the Middle East, where comparisons may be more appropriate, Jordanians place an average of 276 calls per citizen, and Syrians 85.

When it comes to sheer volume of cellular chatter, however, no one beats the Jewish state. Israelis log up to four times the airtime sucked up by Americans, who talk an average of 150 minutes a month. And they do so whether subscribing to Cellcom, with its rock-bottom

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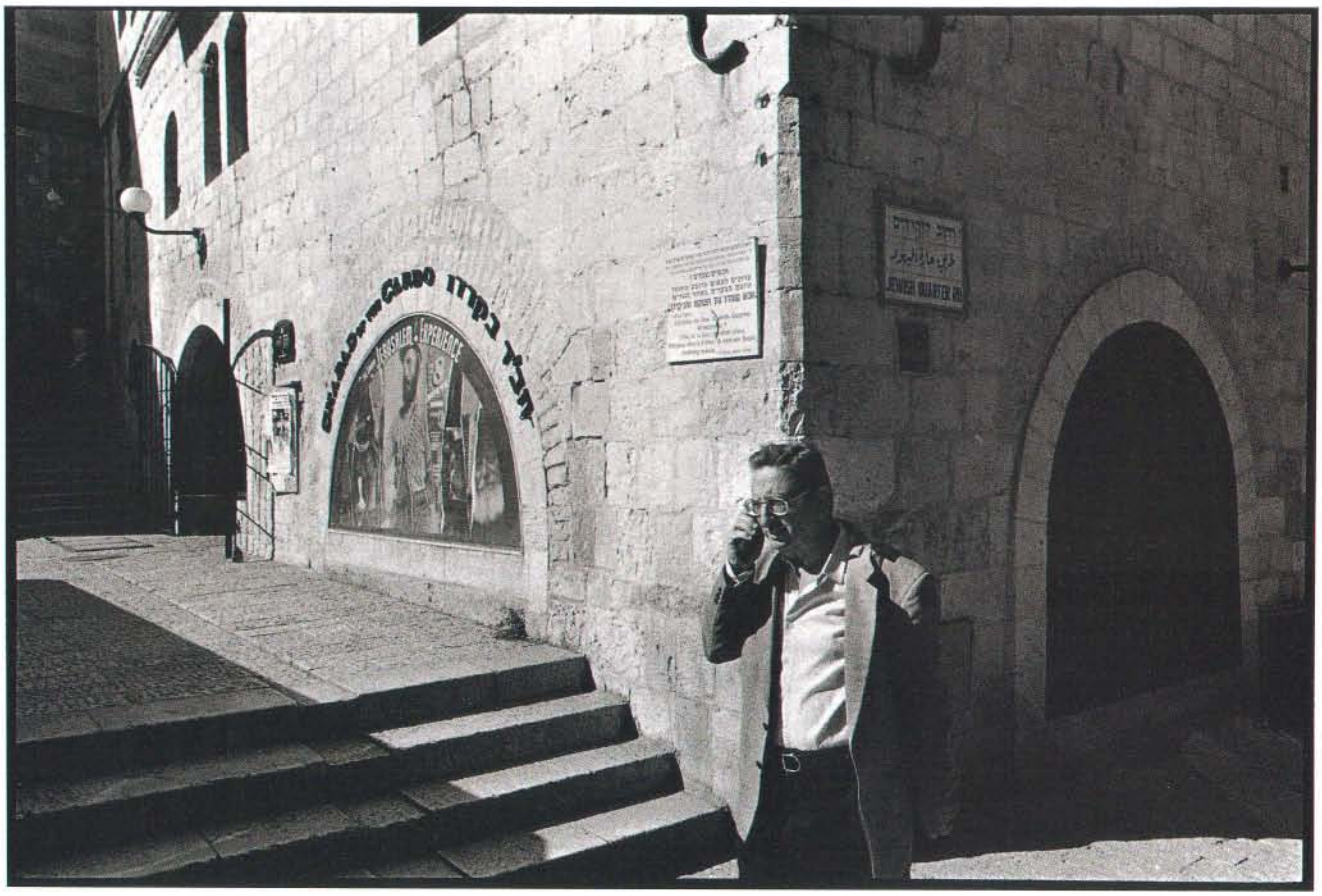
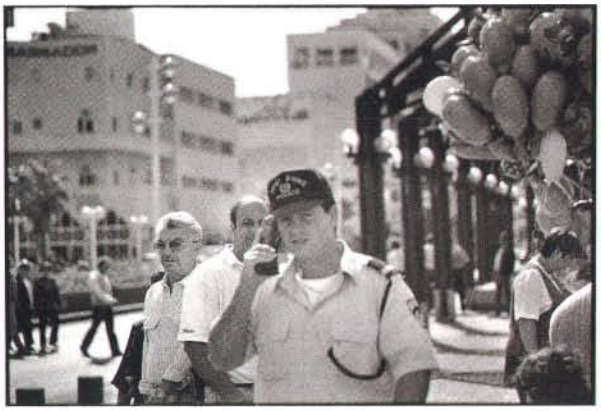
Sheldon Teitelbaum (shelit@aol.com) *is a Los Angeles-based senior writer for* Jerusalem Report, *Israel's leading English-language newsmagazine. He lived in Israel from 1977 to 1986 and served in the Israel Defense Forces.*





rates, or Pele-Phone, whose fees more closely approximate those of American cellular providers.

Following the example set by the country's rabbinical authorities, Cellcom and Pele-Phone now prod customers via brochures and public service announcements to shut off their pelephones during concerts and movies, at restaurants, and especially while driving. Illicit use of cell phones without legally prescribed dashboard microphones or cell phone mounts may be responsible for a recent leap in the already record levels of roadside slaughter.

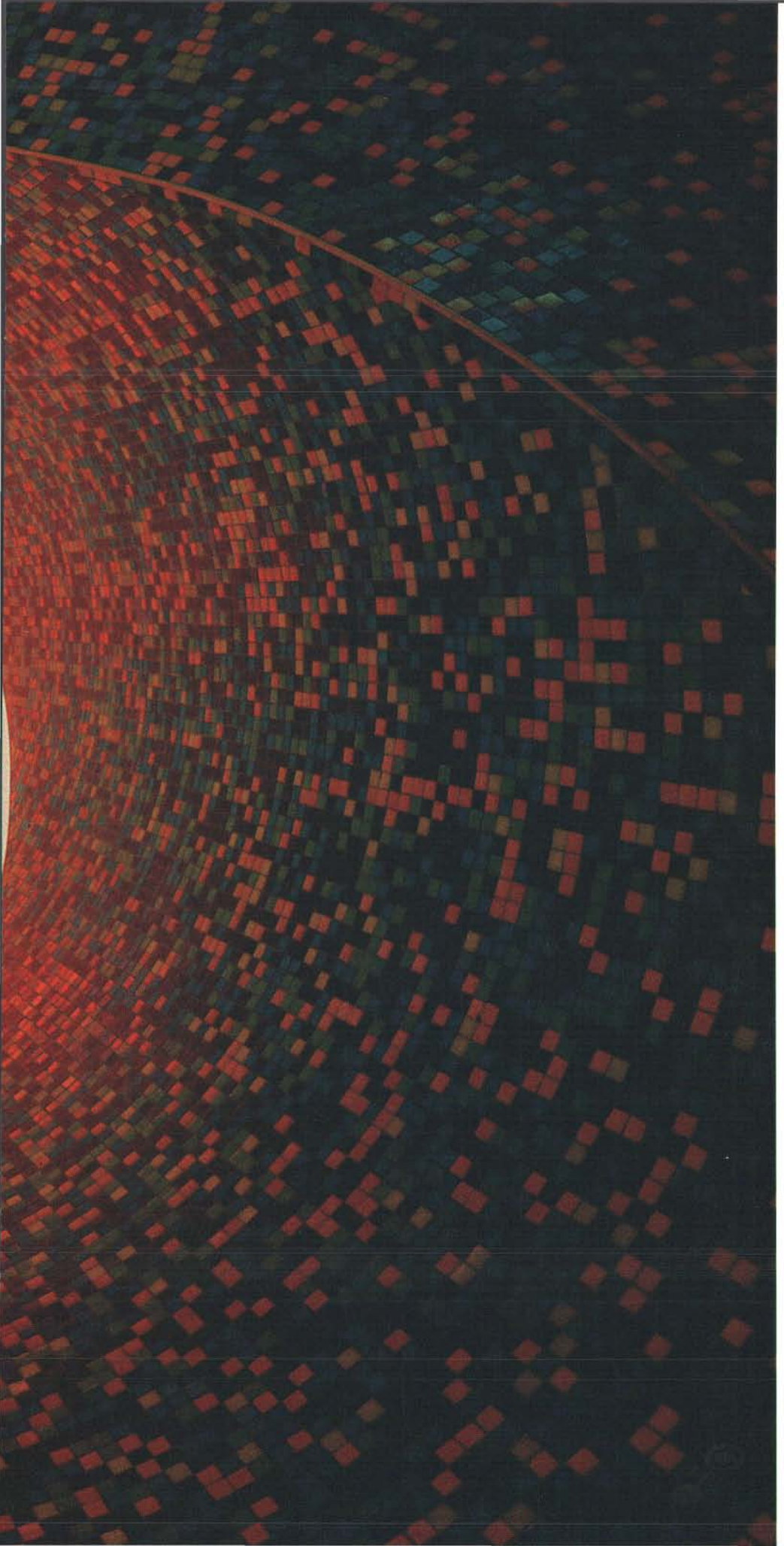
Nothing's sacred. At my son's bar mitzvah dinner, guests flipped open their pocket communicators with abandon, bantering with friends, family, and associates through five courses and coffee. In Israel, if you don't have anything in common with the people you are seated with, the evening is not necessarily lost. You can bring your own company to the table.

Nothing's sacred. At my son's bar mitzvah dinner, guests flipped open their pocket communicators with abandon, bantering with friends, family, and associates through five courses and coffee.

David and Goliath

It didn't used to be this way. Although always militarily up to snuff, the Jewish state was decidedly low tech during most of its formative years. In those days, the newspapers were constantly promising telephones. One year they'd say: People will get phones in five years. Five years later, the word would be: Soon, any day. One peculiar newspaper story in 1960 promised that people who already had phones would "have no cause for complaints in just another four or five years – when the technicians will start attending to breakdowns."

Things didn't get much better for Israeli telephone users until 1984, when the Israel Communications Ministry ordered the country's severely undercapitalized and inefficient telephone provider to go private. The new company, Bezeq, would operate in a quasi-deregulated environment, albeit under continued ministry supervision. 194►



ART HOUSE

When Alessandro Mendini designed the new Groninger Museum in The Netherlands, his intent was to create a space that is as much of a spectacle as the art it displays.

Mendini drafted three prominent architects to employ the surrealists' Exquisite Corpse method of invention – in which, for example, one artist draws a head, another the torso, and so on – to create a truly collaborative feel. The bright mosaic staircase in the central tower (shown here) is a Mendini touch. It spirals up to reveal a stark neon sculpture by François Morellet. "The museum functions as the stage set for art," Mendini says, "and art in turn has a theatrical effect."
– *Anne Speedie*

***Anne Speedie is an editorial assistant at* Wired.**

The

Out on the high risk frontier where mathematics, physics, and finance collide, the enigmatic and hugely successful quant David Shaw is determined to make Wall Street obsolete.

By Thomas A. Bass

Photograph by Neil Selkirk

www.wired.com/5.01/shaw/

The computer revolution is speeding from Silicon Valley to Wall Street, and if David Shaw gets his wish, many of the fat-cat employees at America's major stock exchanges will soon be out of work. "Finance is a pure information processing game," says the Stanford-educated PhD and expert in artificial intelligence and computer design. "A lot of people in the business do things that should be done by computers."

Cold-blooded? Not to the 45-year-old Shaw, who launched the D. E. Shaw & Co. investment bank into the financial stratosphere by using advanced mathematical and computational techniques to play the markets. Almost everywhere Shaw looks into the gray canyons of American finance he sees a mess in need of straightening out. "If computer scientists designed the world, things would be different," he says.

If Shaw sounds smug, consider his remarkable success at turning bytes into bucks. Eight years after it was founded, his investment bank has 400 employees in offices scattered around the globe and US$800 million in capital, with annual returns averaging more than 20 percent. The firm wields a $100 million technological toolbox of secret algorithms, and on a busy day it accounts for 5 percent of the total shares traded on the New York Stock Exchange. Shaw is an adviser to Bill Clinton on computer technology, and he has wired a lot of people into cyberspace through Juno Online Services, which provides free email for about 700,000 subscribers.

That's just the beginning. Over the next year, Shaw will launch FarSight, an audacious online financial service. FarSight will bundle automated stock trading, online checking accounts, financial data, portfolio management tools, credit card accounts, and access to ATM machines into a one-stop financial supermarket. Potential customers run the gamut from savvy investors who need point-and-click stock trading to grandparents fine-tuning their retirement accounts. "Retail customers will get the same services as institutional investors," says Harold Rhodes, FarSight's marketing director. "Why should the big guys get all the goodies?"

Shaw ultimately plans to bundle into FarSight everything having to do with money – from offering insurance to mortgaging your house. It is a package meant to redesign the financial world around a D. E. Shaw interface. Sound familiar? But if we're talking about the Bill Gates of computer finance, why have you never heard of David Shaw?

You will. FarSight, along with Shaw's other financial ventures, which have already grabbed a lot of business from Wall Street's traditional players, is beginning to scare the hell out of the financial services industry. "Technology isn't just changing the

Thomas A. Bass (tab@hamilton.edu), *author of* Vietnamerica *and* The Eudaemonic Pie, *is writing a new book on the world financial markets.*

Phynancier

"We're trying to find areas that are going to be fundamentally transformed by computers. Not just made slightly more efficient, but where the whole industry is going to be turned on its head."

tools we work with; it is changing the nature of the work itself," said Morgan Stanley managing director Elaine La Roche in a speech at the Public Securities Association's annual convention in April. "It allows end users to bypass the middleman. It allows them to bypass us."

The market for online investing and banking potentially represents a large chunk of change. In the next five years, the number of online investing accounts will grow from 1.5 million to 10 million, according to Forrester Research Inc. in Cambridge, Massachusetts. Online banking accounts are estimated to grow from 1.1 million today to 19.5 million by 2001. "The potential shift is huge," says Julio Gómez, a senior analyst at Forrester Research. "The Internet investor will be the cream of the crop, the high net worth individual you have to get if you want to succeed in this business."

Shaw not only wants to succeed, he wants to redesign the financial world from the ground up. "We're trying to find areas that are going to be fundamentally transformed by computers," he says. "Not just made slightly more efficient, but where the whole industry is going to be turned on its head."

Money as fluid flow

In my first telephone conversation with the notoriously secretive Shaw, he sounds more friendly than sinister. He apologizes for having a tight schedule. The night before, he met with Clinton, for whom he has promised a report on computers in the schools. The president wants to spend $2 billion to wire every American classroom to the Internet by 2000. Shaw's report – a blueprint for getting the job done – is late, and he has promised Clinton he'll finish it before leaving on vacation the following week.

"Buckle down and do your assignment," I tell him. "Deadlines are deadlines." Then I casually suggest that if we can't meet before then, perhaps he should take me with him on vacation. To my surprise, Shaw jumps at the opportunity. "I'm not good at vacations," he says.

Shaw is so bad at vacations that he doesn't know where he's going. So I double back to his assistant. She gives me the phone number of a health spa in the Green Mountains of Vermont. Shaw, his wife, and two other couples are driving up from New York the following Monday. I'll be there for lunch.

While booking myself into Shaw's party, I learn from the spa's receptionist that I'm headed to a "camp for adults," a "wellness experience that's guaranteed to destress me and jump-start my fitness program." Not knowing whether I'm in for a powder-puff vacation or a rugged wilderness experience, I pack my car with everything from hiking boots and pitons to yoga mats and beach towels.

On a gorgeous late-summer day, I drive from my house on the upper reaches of the Mohawk River across the Adirondack Mountains into Vermont. I am sitting in the spa dining room when in walks Shaw, a large man with a high-domed forehead. He is accompanied by his wife, a smooth-faced young woman who works as a journalist, and two other couples, a chemistry professor married to a doctor and a lawyer married to a law professor. Shaw is dressed in a black- and gray-checked collarless shirt, black jeans, black socks and shoes. Nursing a bad back, he has spent the morning in his room.

"This is the first time I've ever hiked on the ground, instead of a treadmill," says Shaw's wife when recalling the morning's activities. She gazes onto a forested mountainside. "How do you ski without running into the trees?" she asks. Someone points to a nearby ski trail. I realize I won't be needing my hiking boots and pitons.

The spa director, a roly-poly elf in tennis shoes, comes around to schedule our afternoon massages. Then the lunchtime conversation turns to ideas, which is what Shaw and his friends really care about.

"I never understood the point of vacations," he later confides. "I do all the things I normally do, except with fewer resources." Shaw's friends are meant to help with the resource problem.

His chemist friend launches into a minilecture on the difference between classical mechanics and quantum mechanics and how the latter is so counterintuitive that not even Einstein believed it. The argument essentially boils down to Schrödinger's cat, which simultaneously exists and does not exist – and we don't mean on average, or at one point in time or another, but at this instant right now the cat is both dead and alive – which Einstein had a hard time swallowing. But not Schrödinger, who developed the idea while he and his mistress were summering in the Alps.

"That must have been nice for his mistress," quips Shaw's wife. Everyone laughs.

Shaw and I take this as our cue and head up to my room. I hope the spa director doesn't catch me "re-stressing" his client.

Born in 1951, Shaw grew up in Los Angeles. His stepfather, Irving Pfeffer, was professor of finance at UCLA. Pfeffer

published papers supporting the efficient market hypothesis, a keystone to modern financial theory, which claims that the stock market is so well equilibrated that no one can beat it. Shaw would later make a lot of money by discovering the "inefficiencies," the little pockets of predictability, whose existence Pfeffer questioned.

Shaw's natural father (his parents divorced when he was 12) was a theoretical physicist who studied plasma and fluid flows. His mother is an artist and educator. Shaw is a perfect mix of these three inherited influences. His career exemplifies the melding of physics and finance – a new way of looking at the world that might be called "phynance." Phynance studies money as a kind of fluid flow. It searches for little eddies of predictability in the great waves of speculative investment that wash daily around the globe. Like many of its best practitioners, Shaw practices phynance with the intuition of an artist, and he prefers to live in environments that he has designed.

Planning to study marine biology, Shaw went to UC San Diego, where he was surprised to learn that the subject was offered only to graduate students. Instead, he signed up for cognitive psychology, which turned him on to all the big questions that still intrigue him: How do people work? Will we become obsolete? Will we become immortal?

Shaw became fascinated with information theory and mathematical models for pattern recognition. He also discovered neural networks – computer programs designed to mimic the parallel processing capabilities of the human mind.

"I was just amazed," says Shaw of these very simple systems that can perform exceedingly complex computations. "I was intrigued by neural networks that could automatically learn a pattern. I was very excited about finding these magical devices that, once you discovered the right design, you could turn on and they would get smarter." D. E. Shaw, the investment bank, can itself be conceived as a neural network, a $100 million learning device that just keeps getting smarter.

Disproving the traditionalists

Shaw continued exploring the ramifications of artificial intelligence after he began graduate school in computer science at Stanford in 1973. Among Shaw's colleagues in this famous and talented class were future company founders Len Bosack (Cisco Systems Inc.), Andy Bechtolsheim (Sun Microsystems Inc.), Jerry Kaplan (Go), and Jim Clark (Silicon Graphics, Netscape Communications Corp.).

Until then, Shaw had little direct experience with computers. But in a year or two he had caught up to his classmates and begun pushing into software consulting and computer design. A computer basically consists of a central processing unit attached to memory. You can jazz up the CPU or expand the memory, but the connection between the two will always be limited by something called the von Neumann bottleneck. This bottleneck is caused by the fact that a standard computer can transfer only one chunk of data at a time between its CPU and memory.

What if we threw out the ground rules and designed a completely new type of computer? Shaw wondered.

To overcome the limitations of conventional computer design, Shaw created a new, non-von Neumann computer (called NON-VON, for short), which was loosely based on a different model – the human brain. The blueprint of the NON-VON computer looked like a tree leafed out with thousands of tiny computer chips. Each of these leaf-chips contained several processors, and more processors were attached where the branches met the trunk.

The computer had an ingenious design, similar in many ways to what Danny Hillis later built at Thinking Machines. The machine was incredibly fast. It was also incredibly expensive. "We needed $30 million to get going and $100 million to break even," Shaw said. Planning to start his own supercomputer company, he began shopping the idea to venture capitalists, some of whom would laugh out loud when shown the price tag. "That's not a good sign," Shaw remarks wryly.

In 1980, he snagged a job as an assistant professor of computer science at Columbia University in New York, where he began building a NON-VON prototype. In the course of looking for investors, Shaw became known as a local computer whiz good at running big projects. These skills were in short supply on Wall Street in the mid-1980s, where the big banks and investment firms were desperate to junk their IBM mainframes and boost their computer power with desktop workstations.

Head hunters started calling, and Shaw used their introductions to keep pitching his $100 million idea for a new computer. He never intended to leave academia, until Morgan Stanley & Co. put an extra zero on his annual salary and created an offer too good to resist.

"I was intrigued by neural networks that could automatically learn a pattern. I was very excited about finding these magical devices that, once you discovered the right design, you could turn on and they would get smarter."

> Shaw was acting the part of a New York banker with such gusto that he got cast for the role in a movie.

Morgan Stanley wanted Shaw to be part of an independent, top secret group that was being formed to exploit anomalies in stock market prices. These little pockets of predictability disproved the efficient market hypothesis and opened the way to beating the market. Shaw would put together the group's computer facilities.

Shaw – then a longhaired, bearded, ex-surf musician from Southern California – had some qualms about working for a white-shoe Wall Street firm, but curiosity got the better of him. "What appealed to me was the challenge of trying to beat the market," he says. "I was raised to believe it was impossible, and here they were telling me they knew how to do it."

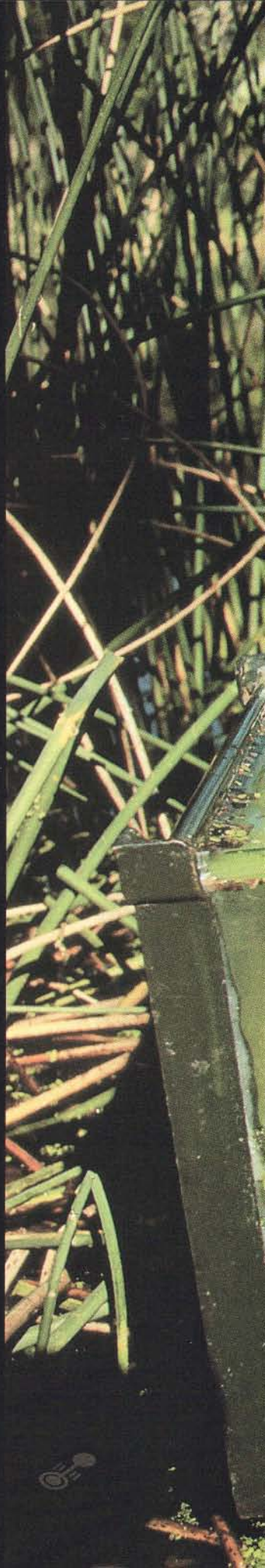
Morgan Stanley was exploiting a technique called pairs trading, which is based on the idea that prices of related stocks should be correlated. Ford and General Motors, for instance, tend to fluctuate in price around the same news events. But what if an unusual gap – in which Ford lags in price and GM pushes ahead – develops?

A hedge fund might rush in to sell GM and buy Ford. If the gap persists and the entire stock market goes up or down, the hedge fund will neither win nor lose. Such strategies, in Wall Street lingo, are called "market neutral." But if the gap between GM and Ford narrows, as predicted by statistical models, then the fund will make money.

The trick is to get your strategy truly market neutral, not only for fluctuations in the stock market, but also for fluctuations in interest rates, foreign exchange movements, and global economic risks that can come at you faster than a shark lunging for red meat. Wall Street is filled with former employees of failed hedge funds.

"This is a high-risk game at the frontier of mathematics, physics, and finance," says Andrew Lo, director of the financial engineering program at MIT. "Many correlations exist among securities at different points in time, and solving the optimization problem that implements a successful market strategy involves the same tools that we use for guided missiles. It's stochastic control theory. You're trying to hit a moving target."

Shaw treated Morgan Stanley like a college campus with a terrific smorgasbord of courses to be sampled. He was acting the part of a New York banker with such gusto that he got cast for the role in a movie. He was walking home one night at 2 a.m., after a long day at Morgan Stanley, when he found his street roped off by a film crew and one of the buildings on his block miraculously transformed into a high-class nightclub. Shaw joined what turned out to be a crowd of extras standing near his apartment. Then the casting director came over and 206 ►



FANTASTIC VOYAGE

In the photographic series *Fish Tank Sonata*, Arthur Tress contrasts environment and artifact with vivid absurdity. The collection contains 120 still lifes that, combined with poems, tell the story of a fisherman's encounter with a spiritual fish. It was a three-year labor of love for the artist, who was inspired by his former landlady – an avid kitsch aficionado – and 19th-century landscape painter Thomas Cole. Despite the juxtaposition, Tress's rubber frogs look splendid and at home in their new setting. "The aquarium revivifies them," says Tress, "and the natural setting gives them air to breathe." – *Erica Ackerberg*

Erica Ackerberg **(erica@wired.com) *is Wired's photo editor.***

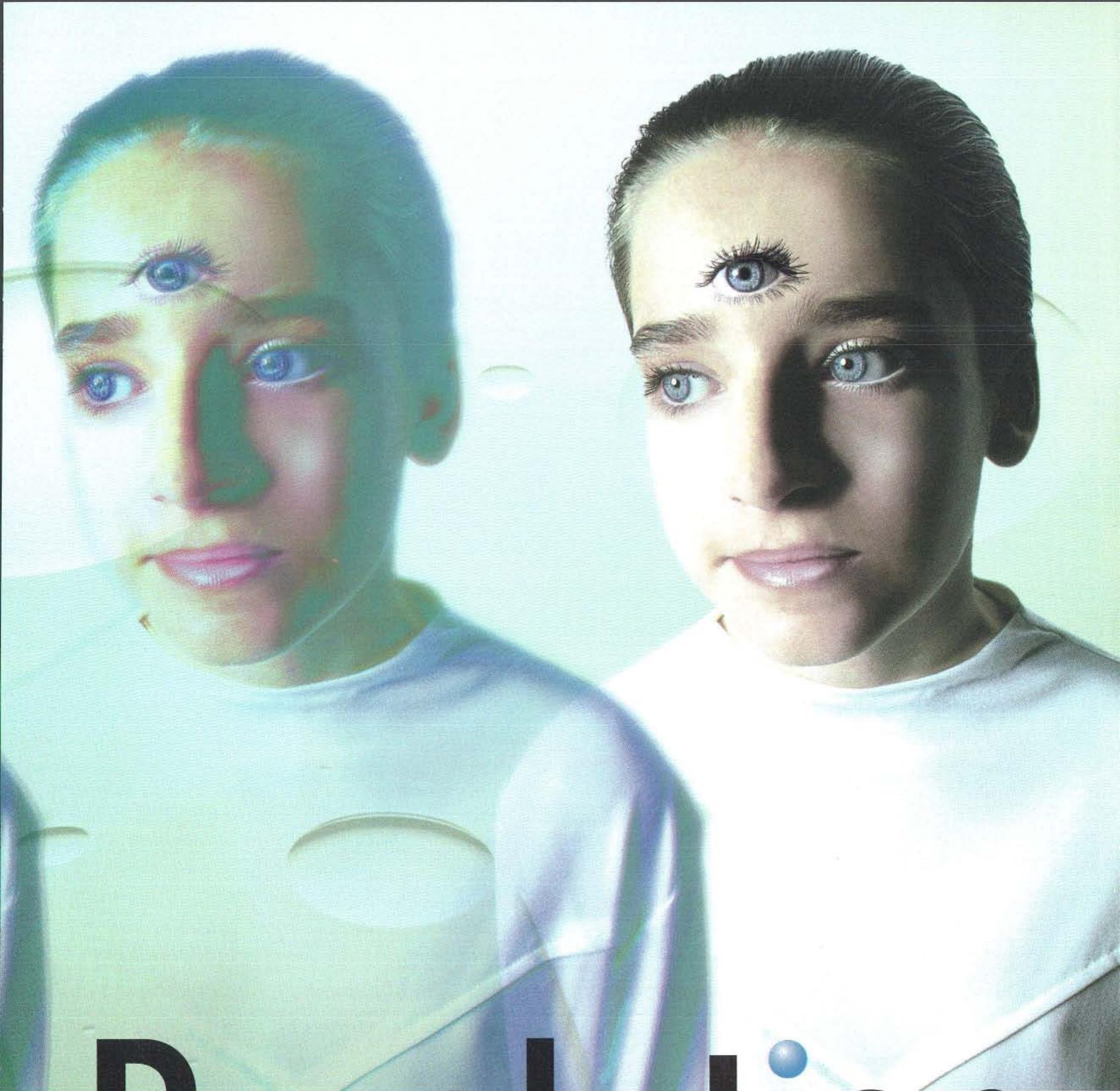
Evolution

Care to reprogram yourself? Customize your kids? Derail evolution?

By 2005, the Human Genome Project will have transcribed the entire programming language of human life.

By Charles Platt

www.wired.com/5.01/genome/



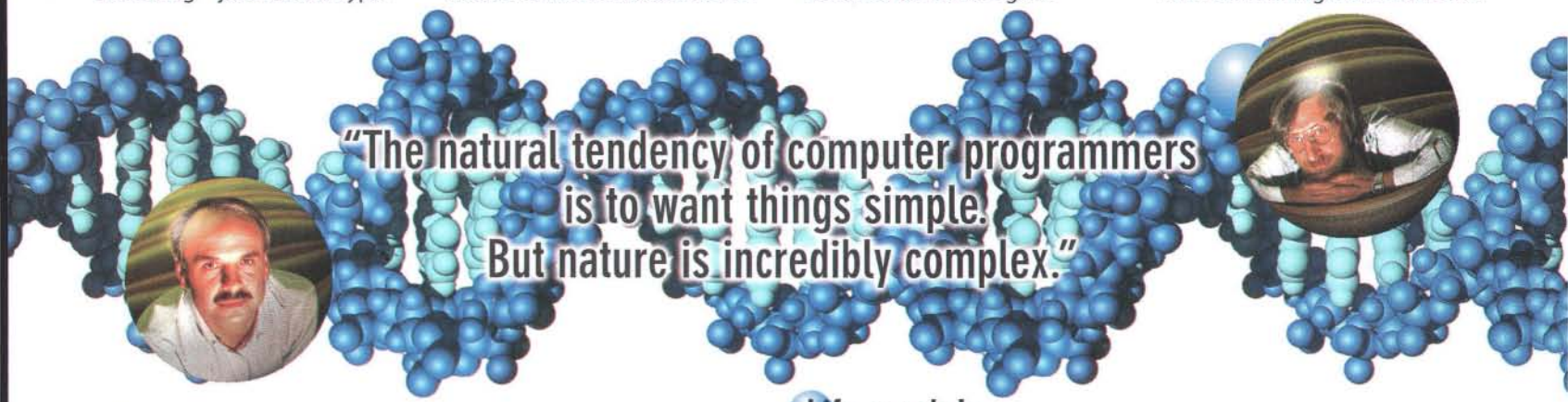
Revolution

ORIGINAL IMAGE: JAMES PORTO

During the past five years a slow collision of epic proportions has united two disparate fields of science. The result promises to be an explosion of new knowledge and power that will sever us from our human heritage and transform us in ways that we cannot yet imagine. If that sounds like overstatement, so be it; this is one occasion where reality should have no trouble matching – or exceeding – journalistic hype.

Twenty years ago, when the term *gene splicing* first entered the human vocabulary, doomsayers wasted no time in denouncing it, while government agencies and ethical study groups were quick to devise guidelines outlawing the creation of "improved" human beings. But Luddites and legislators may ultimately find that genetic information is just as hard to control as any other kind of data. In the long term, people will be able to make their own choices – and humanity will never be the same again.

Boguski (left), Ostell (below), and Gribskov (opposite): not the usual government bureaucrats.



"The natural tendency of computer programmers is to want things simple. But nature is incredibly complex."

The slow collision is between computer science and human biology. A new breed of dual-talented researchers has already emerged. They call themselves computational biologists. Their 3-D modeling software and far-reaching, fuzzy-logic search algorithms are now revealing precisely how genes control our susceptibility to countless diseases ranging from atherosclerosis to breast cancer – and how we can not only cure ourselves but transcend the human condition.

Some time between 2001 and 2005, the Human Genome Project – a global research endeavor coordinated by the National Institute of Health in Bethesda, Maryland – will complete its US$3 billion mission to transcribe the code that controls the creation of human life. At that time, the entire molecular sequence of human DNA will have been reduced to a string of bits that would occupy about 750 megs on your hard drive (somewhat less with data compression). This code will be freely available. In fact, anyone with a modem and browser software can download preliminary pieces of it right now from the project's GenBank Web site. (This is a public service; US tax dollars at work. You don't even need to register. See Related Links on page 204.)

And this is still just the beginning. Once the full sequence of human DNA has been disassembled and annotated, we will be able to recompile the resulting code for our own purposes. We will customize ourselves and our children – and, by extension, their children and their children's children. In this way, we will change the course of evolution itself.

Life models

A multistory white building with dark-tinted windows stands unobtrusively on the hilly, wooded campus of the University of California at San Diego. Through a spacious lobby decorated with lush computer graphics, down a short hallway, we come to a huge white room where monolithic cabinets are crowded together under bright fluorescent lights and the only sound is the muted roar of cooling fans. A Cray C90 looks like a 6-foot chunk of abstract sculpture beside a glass-fronted case containing the baroque plumbing of its five-stage cooling system. Nearby is a newer Cray, a T3D, and behind that an Intel Paragon, containing 400 separate processors.

This is the main lab of the San Diego Supercomputer Center.

Adjacent to the lab is a long, quiet, dimly lit, comfortably furnished room where grad students sit in front of big color monitors. Michael Gribskov, a quietly amiable, bearded man in his late 30s, hands me some 3-D glasses – the kind of liquid-crystal headset that audiences wear in IMAX theaters. Gribskov calls up a wildly complex image on the screen of a Silicon Graphics workstation. It consists of lines entangled with twisting ribbon. The 3-D effect makes it look as if I could thrust my hand into the center of this abstract jungle.

"This is a protein molecule," Gribskov says, "simplified to reveal its structure. Really, there are thousands of atoms here." He clicks a mouse button, and the image changes to show a vast, dense, sprawling mess of tiny spheres. Then he drags

the mouse, and the molecule rotates. Another click, and we zoom in.

Slightly more than 40 years ago, when James Watson and Francis Crick first deduced the structure of DNA, the only way they could check it was by commissioning craftsmen to fabricate hundreds of plug-and-socket metal parts. The scientists then spent days assembling the parts to prove that the atoms really would fit together the way they were supposed to. Even as late as the mid-1970s, chemists were still building models piece by piece, then making measurements with rulers to cross-check the structure against fuzzy images of real molecules rendered by X-ray crystallography.

Computers have changed all that. "But people still think of these structures as being static," says Gribskov. "In reality they have large-scale motions, and with a supercomputer we can simulate this." Animated by the Paragon in the lab next door, the 3-D image on the SGI shivers like a piece of stiff Jello.

Naturally, there's a serious motive behind these complex renderings. DNA controls the creation of protein molecules. When researchers can actually *see* how these microscopic building blocks fit together, they can understand their behavior. They can also use the data to predict whether compounds will "mate" successfully. Finally, they can establish a smart online database with which scientists can access that information – exactly what Gribskov and his team are doing.

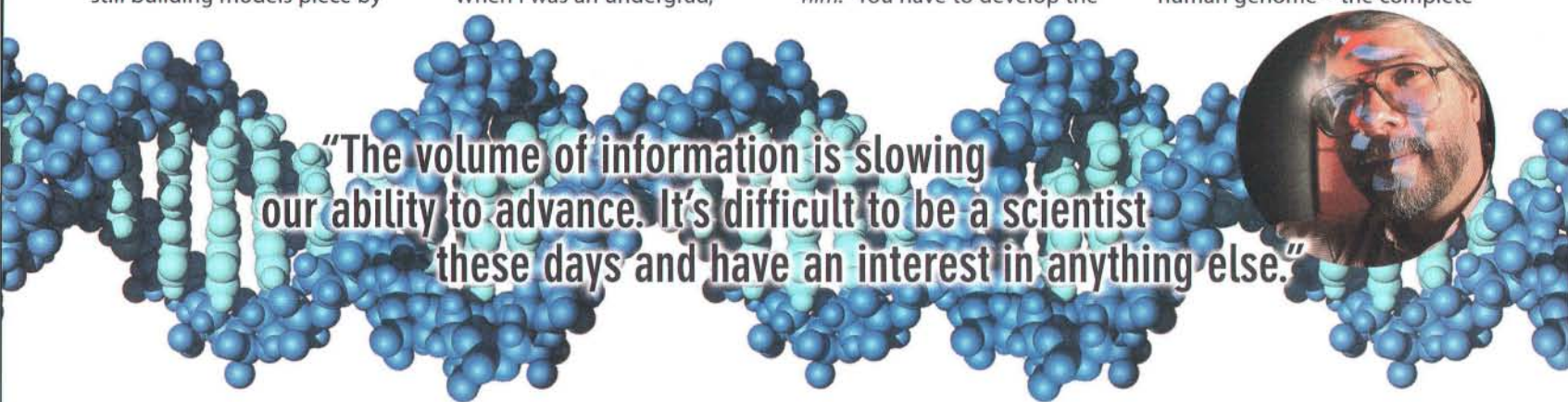
SDSC's database also enables researchers to sort and compare molecular structure in an intelligent way, to make sense of all the data, which is doubling in quantity every 18 months. "When I was an undergrad," Gribskov says, "a pretty complete molecular biology book was a paperback less than 2 inches thick. Now, you couldn't cram it into a shelf of books. The volume of information is so extreme, it's slowing our ability to advance. It's very difficult to be a scientist these days and have an interest in anything else."

Upstairs in his small, modern office on the third floor, Gribskov makes himself comfortable in front of a Digital Alphastation and launches Netscape. A moment later we're at his homepage at The National Biomedical Computation Resource at SDSC. A couple of links from there we reach the data he's been compiling, complete with pictures.

"I'm a practical person," he says, "so I want the things I do to be useful. Over the years, a lot of people's work has not been implemented and has ended up merely as a footnote to history." He shakes his head; clearly, he doesn't want that to happen to *him*. "You have to develop the product for the end user," he says with a smile.

And what, precisely, is the application?

"Proteins like this," explains Gribskov, nodding toward the image displayed by his browser, "are implicated in many forms of cancer. Once we understand them, this will make a huge difference in medicine. Today, to cure cancer we give you a drug that kills all the cells in your body that are actively dividing. In the future, we'll give you a drug tailored to kill that cancer cell and that one only."



"The volume of information is slowing our ability to advance. It's difficult to be a scientist these days and have an interest in anything else."

One molecule fits all

Genetics used to be a hopelessly vague science. Everyone knew that traits were passed from one generation to the next, but no one understood how. Scientists theorized that each trait was communicated by a microscopic messenger known as a gene, and that if you put all the genes together, they would form the human genome – the complete genetic code it takes to make a human. But no one knew how the genome worked or what it looked like.

In 1953, it was revealed that deoxyribonucleic acid, a copy of which sits in every cell, functions as that control mechanism. The human genome consists of about 100,000 genes – short sections of DNA that tell a cell how to build proteins, the basic building blocks of life.

Variants of DNA exist in all living things, from bacteria 198 ►

Charles Platt writes frequently for Wired, *most recently "They Render unto Bill" (*Wired *4.07).*

PHOTOGRAPHS: BOGUSKI AND OSTELL: MIKKEL AAL; GRIBSKOV: JAMES DICKENSAND; DNA STRAND: K. EWARD/BIOGRAFX/SCIENCE SOURCE/PHOTO RESEARCHERS

Wired: Working at an institution founded by Thomas Jefferson, what sort of mantle is passed on to you?

McDonough: I have the same design assignment he did: How are we meant to pursue life, liberty, and happiness free from remote tyranny? In my case, I am calling for the Declarations of Interdependence, but I'm focusing on the same issues. Perhaps now the remote tyranny is not George III – but it's an intergenerational remote tyranny. We're actually tyrannizing future generations.

Intergenerational tyranny?

The question no longer is what are we going to leave behind for our children, but what are we not leaving behind? Like trout. If we permanently destroy genetic information and don't leave that as a resource, and we persistently toxify the planet, what we have left is a poisoned place, devoid of valuable information.

In choosing to stake his professional future on an issue as potentially tedious as "the environment," architect and designer William McDonough has become a master of the buzzword. He frequently challenges American businesses to "use current solar income" and remember that "waste equals food" while he champions the coming of the Next Industrial Revolution and outlines his eco-manifesto, which he calls the Declarations of Interdependence.

McDonough, the University of Virginia's dean of architecture, recently launched the Institute for Sustainable Design. Last year, DesignTex Inc. released a McDonough-designed line of fabrics made with biodegradable fibers and reengineered chemical processes. "They are so safe," he says, "you can eat them."

How does the Next Industrial Revolution change things?

It allows us to dematerialize – we start to think more in terms of information and less in terms of stuff.

What will the Institute for Sustainable Design do to address this?

It will "render things visible." We'll have regional planning data available where we can show what it means to allow the present course of activity to play itself out, so people can come see what it looks like. They can see, for example, what the effect of sprawl will be if they don't do anything. So we can project a tragedy.

If what we are doing now is a strategy, it's a strategy of tragedy. A strategy of hope would require a strategy of change. And therefore we have to be willing to change immediately.

What does that require?

It's a way of looking at the world. The business community has adopted something called eco-efficiency, the idea that we can reduce our toxic conditions but we discern our energy consumption as separate. From my perspective, eco-efficiency is a derelict notion. It essentially says that you wake up in the morning feeling really guilty, and then you say, "Well how can I feel better by being less bad today?" All you've done is stretched out the agony. You haven't changed what you're doing. The question is would you rather die by slow torture, or would you rather be shot?

So instead of eco-efficiency, we said: What would a sustainable agenda look like? You have to project what "100 percent sustainable" looks like in order to measure your progress. It makes you become a designer.

Unlike many defenders of the environment, you avoid the term "recycling" in favor of "downcycling." What do you mean?

We're actually losing the quality of the materials. As long as you keep converting carpets and milk jugs into park benches, you're not recycling – you're downcycling the quality of the petrochemical. It's losing quality. You can never get it back to being the jug, because it's being contaminated with all sorts of other things.

So current recycling practices are inadequate?

More than inadequate. They're probably dangerous. When I see a milk bottle becoming fabric on your back and realize that it's full of anti-oxidants, UV stabilizers, and anti-ammodium residues from catalytic reactions and plasticizers, I think, Wait a minute. That was never designed to be next to human skin.

The largest carpet maker in the world has adopted our principle of cradle-to-cradle design. You can lease their carpet and they'll take it back as a technical nutrient. They render it back into carpet – forever. It doesn't get downcycled.

Bureaucracies are infamous for being unresponsive. Yet you've worked for huge companies like The Gap, Wal-Mart, and Herman Miller. How do you manage to penetrate the corporate culture?

I work only with the chairman of the board, and after explaining what we do, I've never had anybody come back and ask me to please give it to them energy-inefficient and toxic. We can show that the economics of buildings are irrelevant next to the economics of employees.

How would that manifest itself in a corporation?

Productivity. Just enjoyment – and also avoiding liability. It's not a small issue. We always make our offices as much like the outdoors as possible, so you feel refreshed at the end of the day. Then you go home to your cave and family and hunker down.

So that people are saying, "I can't wait to go back to work"?

Our argument, when we work with corporate leaders, is very clear. How many people do you think get up in the morning and can't wait to get to their gray rectangle under that neutral fluorescent light? And the air is bad on top of that.

Would Jefferson have sympathized with your agenda?

Mr. Jefferson understood very thoroughly what this idea of intergenerational responsibility was all about. In 1789, in a letter to James Madison, he said, in effect, The earth belongs to the living. No man may by natural right oblige the lands he owns or occupies to debts greater than those that may be paid during his own lifetime, because if he could, then the world would belong to the dead and not to the living. ■ ■ ■

Vernon Mays is editor of Inform, *an architecture and design magazine in Richmond, Virginia.*

BACKGROUND: THOMAS JEFFERSON PAPERS, SPECIAL COLLECTIONS, MANUSCRIPT DIVISION UNIVERSITY OF VIRGINIA LIBRARY; PHOTO: SKID

Declaration of Interdependence

According to eco-architect Bill McDonough, failure to protect the environment is intergenerational tyranny, and the key to saving the planet isn't more regulations, but better design.

By Vernon Mays

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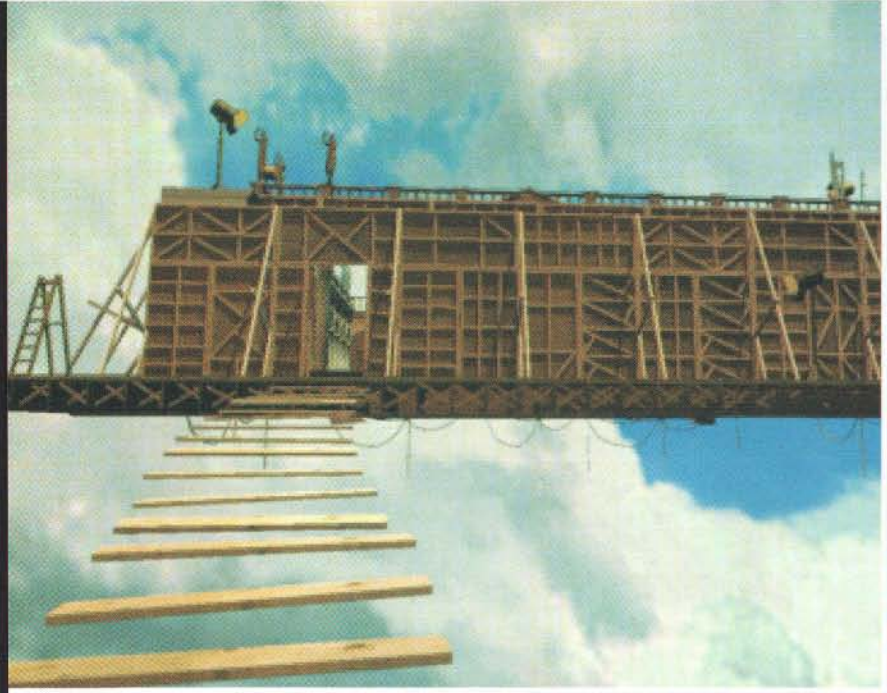

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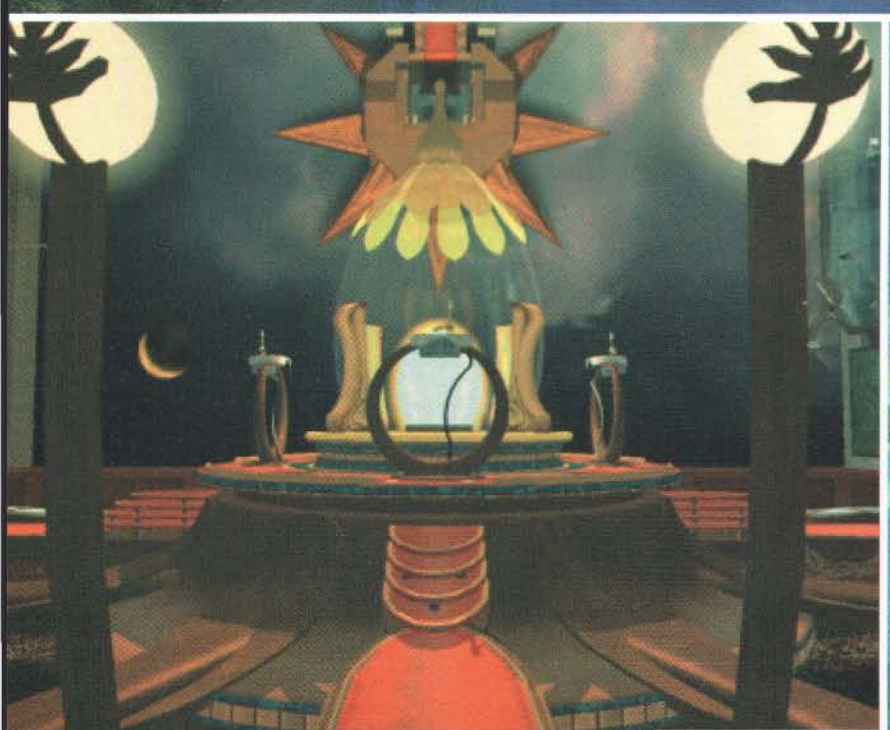
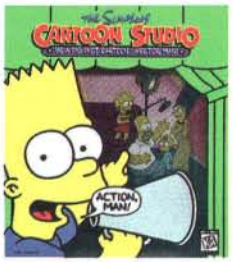
YOU ARRIVE, A STRANGER IN A STRANGE LAND, CONFUSED, DISORIENTED, YOU MAKE YOUR WAY THROUGH THE TWISTED SURREAL WORLD IN SEARCH OF YOUR PARTNER, MAX. ALL YOU CARRY WITH YOU IS THE KNOWLEDGE YOU'VE GROWN TO ACCEPT AS THE TRUTH. BUT YOU'RE ABOUT TO DISCOVER THAT WHAT THE TRUTH IS DEPENDS ON WHAT WORLD YOU'RE IN, AND IN THIS WORLD, THINGS DON'T NECESSARILY WORK THE WAY YOU MIGHT EXPECT THEM TO. THE CHARACTERS DON'T EXACTLY ACT THE WAY THEY'RE SUPPOSED TO, THE LAWS OF PHYSICS HAVE SOMEHOW BECOME WARPED. WHAT IS UP AND WHAT IS DOWN IS MERELY A MATTER OF OPINION. HERE, AFTER EVERY PERPLEXING PUZZLE YOU SOLVE, ANOTHER LURKS AROUND THE CORNER. AND AS YOU UNRAVEL EACH ELUSIVE MYSTERY, AN EVEN BIGGER ONE BEGINS TO UNFOLD. THE QUESTION IS, WILL YOU BE ABLE TO PUT THE PUZZLE TOGETHER AND MAKE THE RIGHT CHOICE WHEN THE TIME COMES?



Mmmm, Digilicious

Remember that *Simpsons* episode where Lisa elopes with Abu? Or the one where Homer is abducted by aliens? No? That's because you can see these only on my computer. 'Course, if you had the *Simpsons Cartoon Studio* CD-ROM, you could make yer own never-before-seen *Simpsons* cartoons like these.

Fox's *Simpsons Cartoon Studio* may be more the '90s answer to Colorforms than a finely tuned animation resource, but dang if it isn't fun to watch Smithers and Mr. Burns hula across the monitor as a three-eyed fish swims by. Mix together a slew of ready-made images, pre-animated sequences, available props, and assorted backdrops, then slap your name on the credits and email it to a friend. The droll sound effects include clips of Homer saying "Mmmm, doughnuts," "Mmmm, pork rinds," and two versions of "Mmmm, waffles."



Cowabunga!

Even with all the editing tools, I flubbed the procedure and created a cartoon where Bart freaks out *before* his science experiment erupts. (I called it "Bart the Prophet.") For the anally inclined, there's certainly a way to have these cartoons make more sense. But I prefer to toss rhyme and reason out the window. Ned Flanders mows the sky and household appliances rain from above. So what if it's nonsensical? We can't all be Matt Groening. – *Erika Milvy*

Simpsons Cartoon Studio: US$39.98. Fox Interactive Inc.: +1 (310) 369 1000.

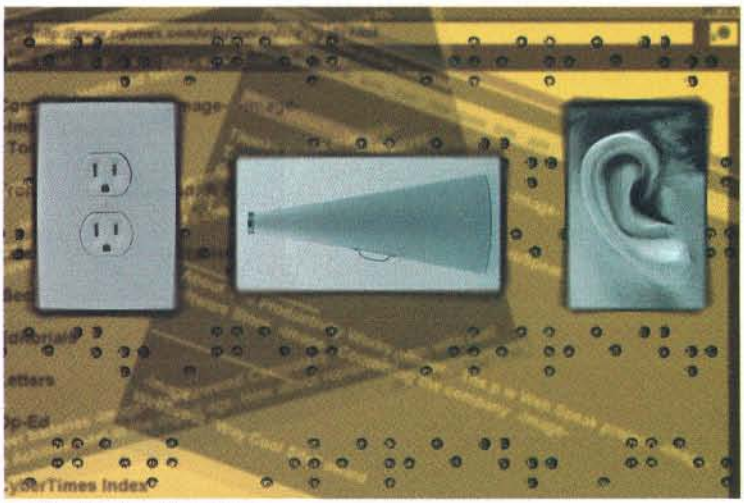
See Hear

Like the world needs another Web browser. But wait, this one is different. It talks, and it's designed for millions who have been locked out of cyberspace.

pwWebSpeak has caused a stir among sight-impaired people, for whom the Web is a new and rich source of information, but who are grappling with how to use a mouse to click on images they can't see.

As a blind person working with adaptive technology, I'm used to having to learn new ways to crack a nut (or break Windows). Registering with HotWired using Netscape and one of the packages that try to make Windows speech-friendly is like threading a needle – with boxing gloves on. But with pwWebSpeak it's a breeze, even with all the images HotWired forgot to label, which leaves pwWebSpeak saying: "Image without caption, image without caption ..." Happily, it even reads articles without labeled graphics.

pwWebSpeak provides good clear menus for those with enough sight to see the magnified visuals. For a totally blind person, a few simple keystrokes give access to all the flexible and powerful navigation functions. This makes it easy to find your way around the most complicated hypertext, gets you quickly to what you're looking for, and reads it clearly, spelling words out if necessary. Forms and tables, which are notoriously tricky with other speech packages, are presented sequentially and logically. pwWebSpeak supports a wide range of speech synthesizers used by sight-impaired people, as well as two software-only speech engines driving SoundBlaster.



Driving blind on the infobahn.

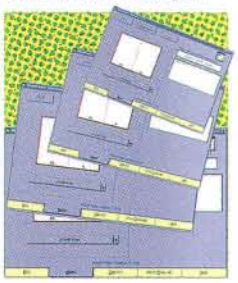
This innovative package proves its worth for anyone needing speech access to intranet systems or to the wider Web – not just the sight-impaired, but those with other reading difficulties, including foreign language students. It opens up new opportunities for employment, study, and leisure. And with future plans for support of voice-driven command, pwWebSpeak is just getting started. – *Peter Bosher*

pwWebSpeak: US$250 (consumer), $125 (nonprofit and educational). The Productivity Works Inc.: +1 (609) 984 8044, fax +1 (609) 984 8048, on the Web at *www.prodworks.com/*.

Harder Copy

Using the latest browser and a full complement of plug-ins is all very well, but what happens when you decide your eyes have had enough, and some good old-fashioned hard copy would be nice? If you habitually turn to the built-in print facilities, think again. Do you really want to deal with the mélange of fonts, graphics, and assorted control characters your marvelous software has seen fit to foist on your printer? No way. What you want is WebPrinter.

Spotting a transient gap in the market, Forefront has come up with this imaginatively named program that will print any Web page as a neatly numbered, double-sided booklet. It will also shrink text and graphics to fit on whatever size paper you are using and lead you by the hand through every step of the process. The interface has the look and feel of a Microsoft Word print preview, with all the buttons and fonts clearly labeled. Most of the functions are more or less intuitive, but the double-sided printing, while cute, is not.
– *Gabriel Ratcliffe*



When pixel meets print.

WebPrinter: US$24.95. Forefront Group Inc.: (800) 653 4933, +1 (813) 539 7283.

Videos on Fire

Hong Kong movie lovers have always had a love-hate relationship with Tai Seng Video Marketing, the largest US distributor of those ingeniously manic films. When these fans have exhausted the mongrel selection available in mainstream video outlets – most of which are atrociously pan-and-scanned and dubbed – they turn to Chinatown, where store shelves are stocked with Tai Seng videos. But owing to the fast-buck indifference of Hong Kong studios, the quality and accessibility of these movies are hit-and-miss – dubs are often low-grade, English subtitles unreadable or nonexistent.

Now, Tai Seng is wisely playing catch-up and diving headfirst into the mainstream market. Its New Edition video series boasts excellent letterbox prints and easy-to-read yellow subtitles designed for a non-Chinese audience.

Two of its first releases are excellent: the lyrical fantasy-romance *The Bride with White Hair* is achingly beautiful and gloriously blood-drenched, and *The Heroic Trio* is an imaginative, futuristic action-adventure starring Hong Kong's top actresses as the title's world-saving ass kickers. There are also worthwhile moments in the traditional martial arts *Wing Chun*, and *Heroic*'s sequel, *Executioners*. These last three star Michelle Khan (also known as Michelle Yeoh) – a find for those already mesmerized by her lithe, break-neck magnificence as Jackie Chan's partner in *Supercop*.

Tai Seng: when you need a *Drunken Master* like a *Bullet in the Head*.

These films should soon be stocked in most major video outlets in the US. They are also available through mail order by phone or via Tai Seng's Web site, which has a comprehensive rundown of the company's extensive library of titles.

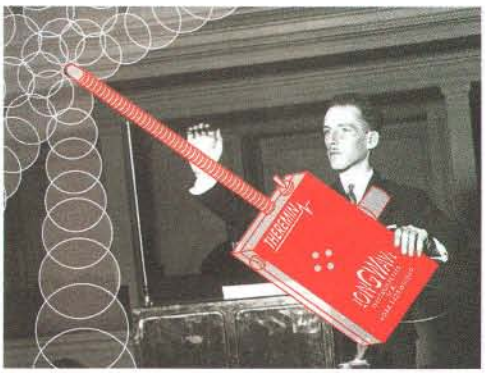
I recommend starting with John Woo's war-torn masterpiece, *Bullet in the Head*; Chan's greatest work, *Drunken Master II*; and Jet Li's Shakespearean kung fu classic, *Fong Sai Yuk*. Now the only reason to go to Chinatown on video night is for kung pao chicken take-out.
– *Wagner James Au*

New Edition videos and laserdiscs: US$39.95 to $89.95. Tai Seng Video Marketing: (800) 888 3836, +1 (415) 871 8118, on the Web at *www.taiseng.com/*.

Good Vibrations

If you caught The Orb on tour recently, you might have noticed a band member moving in front of a box-and-aerial arrangement to produce daft, badly tuned radio noises. What he was playing was a crude version of the theremin, source of the otherworldly voice from a hundred '50s and '60s sci-fi soundtracks (notably *Star Trek*, *The Forbidden Planet*, and *The Day the Earth Stood Still*) and currently one of the hottest pieces of retro musical gear around. Terrorvision has one, Portishead bought one (but faked the sound on the opening track of *Dummy*) and now, with the arrival of the Longwave's Pocket Theremin, you can have one, too.

Leon Theremin's original design, invented in the 1920s when he worked as a radio operator in Russia, was as big as a desk and featured two antennae. Leon had discovered that the frequency of a particular circuit could be altered depending on the capacitance of the air between his hand and a vertical antenna. The second horizontal antenna employed similar principles to affect amplitude, or volume.



Does air sing?

Longwave Instruments' US$125 box, by comparison, has one antenna to control pitch, a small built-in speaker, an on-off switch, volume control, a single audio output, pitch-trim control for setting the output range, and little else. There's no volume antenna: you'll have to make do with a volume pedal instead – the sort guitarists use – but at least you can carry the Pocket Theremin in your coat.

It's almost impossible to play anything other than an unpredictable, eerie wail. However, if you run an audio cable from it into a studio effects box such as a reverb or a delay line, you can create your own convincing B-movie atmospherics. It's just begging to be sampled and used in a music track.
– *Daniel Diver*

Pocket Theremin: US$125. Longwave Instruments US: +1 (408) 374 6439, email *fringex@aol.com*

Ruin Your Love Life with GP2

The good news: *Grand Prix 2* is on the streets. The original was a Formula 1 racing extravaganza that leapt to the top of my twitchometer. With time, I was winning on the hardest level, leading to the illusion that I could, just maybe, *coupe le moutard* at the real thing. Now the bad news: *GP2* shattered my dreams.

Since I was the total dog's gonads at the original, I selected the hardest level straight off. Mistake. *GP2* is *hard*. I accelerated out of a corner too fast and spun into oblivion; I slammed on the brakes and ate run-off gravel. The extra sensitivity is infuriating at first, but there is a

Heartbreaker.

mouthwatering challenge awaiting those who survive (life expectancy of a novice: under a minute).

Nearly all of the 1994 Formula 1 rule changes are acknowledged. You can even play with car-to-pit telemetry settings. The 3-D graphics engine is a triumph. When you find yourself leaning off your chair as you enter a tight corner, then tensing up as you slam into a wall, you know the game's designers are on top of things.

The drawback is that *GP2* will take months, if not years, to master. I'm sorry, Michelle. You do understand, don't you? – *Rob Dodson*

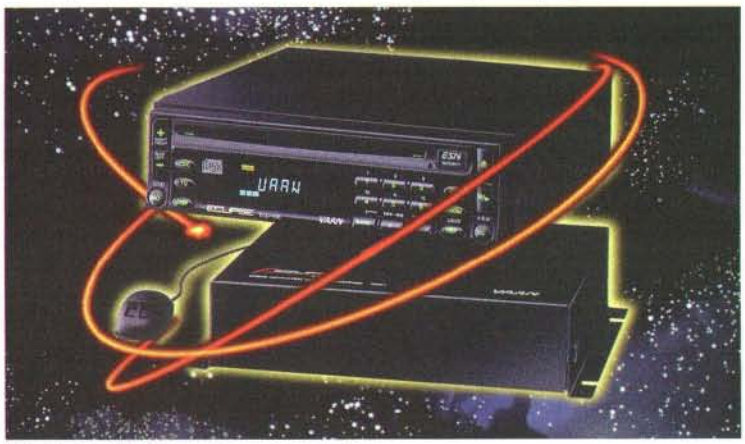
Grand Prix 2: US$55. Microprose: +1 (510) 522 3584.

Get Lost

As millions of wives and girlfriends will tell you, men seem to be genetically incapable of doing two things: putting their dirty socks in the hamper and asking for directions. While the electronics industry has, sadly, yet to come up with a sock-guzzling hamper, the other problem has been bravely addressed by manufacturers like Kenwood and Fujitsu Ten. Drivers can now tell a computer where they want to go, and the darn thing actually gives them directions over the car's speakers. No more being lost and red-faced at the mercy of strangers.

I drove around for two months with Fujitsu's Eclipse 9001 VAAN system (that's Voice-Activated Audio Navigation to you) installed in my car (thank you, Cartunes II in Middletown, Connecticut). The system consists of a plain, black metal box that goes under the front seat; a microphone mounted to the rear-view mirror or sun visor; and Eclipse's radio/CD player (touted as a high-quality unit, although mine refused to read the last three or four songs on many CDs).

To start the fun, you feed the player one of four supplied CD-ROMs (each covers different regions of the US), and a voice asks you, "Do you want to navigate?" From there on, you can pretend to be Dave Bowman, the astronaut in Kubrick's *2001: A Space Odyssey* – except that VAAN, unlike the mutinous HAL, won't give you any lip. You tell it



"Navigator, find me a cheeseburger."

where you are and where you want to go; it maps out the best route and stores it in memory. Now eject the CD-ROM and put on some bitchin' Mantovani. VAAN wakes up whenever you bark "Navigator," then gives you bite-size directions before discreetly nodding off again. Every time you've completed VAAN's previous instruction, simply say "Next" to proceed.

The good news is that it works. The bad news is that it often doesn't work very well. The computer talks to you in English, but it doesn't understand more than a few choice words: you have to slowly spell out street names and numbers character by character. Even then, it frequently mishears what you're saying. For short city trips, the procedure is often too time-consuming and not worth the bother – a plain old map will do. For longer excursions, though, VAAN could come in very handy, provided you don't go from one region you've paid for to another you haven't. You see, Fujitsu has divided the country into more than 20 metropolitan regions, with more to follow. Unlocking those regions means buying codes for about US$80 each.

Although its technology and interface need work, Fujitsu's technotoy is still ahead of the curve. – *Rogier van Bakel*

Eclipse 9001 VAAN: US$649.99; works only with Eclipse ECD-416 CD player, $789.99. Fujitsu Ten: (800) 233 2216, fax +1 (310) 476 4375.

Light Shines Darkly

***Of Light and Darkness* is a somber first-person adventure game featuring the surreal work of award-winning artist Gil Bruvel. The story centers on Mike and Serin, brother and sister, who are visiting a Beverly Hills mansion for a private showing of a mysterious artist's work. While observing one particularly engrossing painting titled *Avant-Garde*, Serin is supernaturally and unceremoniously yanked into the artwork's universe. Mike, who apparently never had the time to watch even a single episode of the '70s TV show *Night Gallery*, pounds his fists against the abductive painting, only to find himself also transported into the illusory universe beyond the canvas. As the game begins, Mike – and you, the player – stand looking back through the painting at the horrified faces of the other gallery-goers as they stare, aghast and unbelieving.**

***Of Light and Darkness* mixes computer-modeled speaking characters, live actors presented via full-motion video segments, and attractive, brooding 3-D**

Get sucked into adventure – literally.

graphics. The goal is to find and rescue Serin from the surreal dangers of Bruvel's artwork and, if all goes well, to re-enter reality. Along the way, players explore the various realms of the French artist's delirium (without giving away too much: the Murmur Room, the region known as Mechanos, and the rather frighteningly named Euclidean Terror Chamber). *Of Light and Darkness* also showcases a graphics engine that allows players to examine, pick up, and use items in fully rendered surroundings. Objects and environments within the game react to each other in accurate light/shading effects including reflective surfaces, multiple light sources, and realistic shadows. *Of Light and Darkness* is, at its core, a game about and filled with art, with a subtle – and perhaps unintentional – message about the ghostly line between muse and madness.
– *Chris Hudak*

Of Light and Darkness: US$49.95 (estimated). Interplay Productions: (800) 468 3775, +1 (714) 553 6678.

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Alternatively, visit our Web site on:
http://www.webwidemedia.com

Bumpy Lumpy ***Koala Lumpur: Journey to the Edge*** **pits a marsupial mystic against impending doom – yes, the Comedy Apocalypse. Developed with Colossal Pictures, the game is packed with nutty cartoon worlds, biting humor, and a slew of wacked-out characters.** *Release: Early February. Brøderbund Inc.: (800) 521 6263, +1 (415) 382 4700,* www.broderbund.com/.

Gots Wires **In the wake of telecom deregulation, Boston Edison Company and RCN Inc. have teamed up to provide one-stop shopping for Boston-area telephone, video, Internet, and energy needs. With the advantage of Edison's extensive right-of-way in the Boston streets, these two may form another competitor in the race for next-gen telecommunications service.** *Release: 1997. RCN Inc.: (800) 672 2832, +1 (617) 266 5000.*

Whoops **It looks like Armageddon has finally arrived, and it's your fault.** ***Realms of the Haunting*** **is a brooding and macabre fantasy action-adventure game set in the Cornish country village of Hellston. Your charge as the young Adam Randall is to reunite the broken Shrive with the Soulstone to save the earth – and yourself as well.** *Release: February. Interplay Productions: (800) 468 3775, +1 (714) 553 6678,* www.interplay.com/.

Start-up **Fast Company is joining** ***MoneyHunt****, a new PBS TV show aimed at entrepreneurs. The two companies will be sharing content and promoting each other's properties, Net sites, and special events.* ***MoneyHunt*** **has already built a cult following in Connecticut, but will it fly in Peoria – or San Jose for that matter?** *Release: January. Fast Company: (800) 688 1545, +1 (617) 973 0300,* www.fastcompany.com/, www.moneyhunter.com/.

What say you? **Douglas Hofstadter offers his book** ***Le Ton beau de Marot****, an investigation of the subtleties of creativity and language – "the spark and sparkle of creative translation."** *Release: March. Basic Books: (800) 242 7737, +1 (717) 941 1500.*

Ellipsoids **Andrew Spencer Studios'** ***Ecstatica2*** **takes a different tack toward modeling the game's 3-D graphics, using ellipsoids rather than polygons. The result? Lifelike characters that move and react well.** *Release: March. Psygnosis: (800) 438 7794, +1 (415) 655 8000,* www.psygnosis.com/.

RESIZING THE WORLD

The Web has always been touted as having incredible potential for education. But that noble cause has been lost in the bazaar of virtual malls and corporate Web sites that hawk products with the latest online technological gizmos. GlobaLearn, a nonprofit Connecticut-based company, is rekindling the education flame.

With grant money from individuals, foundations, and corporate supporters, GlobaLearn is taking more than 30,000 students from the US and 24 other countries on a trip across Asia – through the Web.

Beginning this month, the students, along with parents and teachers, will follow the adventures of four "Marco Polos" who will retrace the explorer's historic passage from Venice to Hong Kong. Over 146 days, 8,500 miles, 15 countries, 4 seas, 2 deserts, and a strait, the Trans-Asia Expedition team will visit 31 host families and report its findings on the GlobaLearn Web site.

Acting as the eyes and ears of the students, each explorer will take pictures, keep a journal, log miles traveled, and act as a correspondent between the people of Asia and the students online. The children of the host families will be in contact as well, contributing information about their families, schools, and neighborhoods.

The photos, journals, and reports will be updated daily along with suggestions for classroom activities to help teachers use the expedition as part of their curriculum. The Web site also provides a forum for students to converse with each other and post artwork and writing.

The Trans-Asia Expedition is the third of its kind staged by GlobaLearn: it follows treks through Turkey and the countries surrounding the Black Sea. But this trip through Asia will be the biggest to date: it will last five months and cost around US$1 million.

In spite of the allure of jazzy online tech, GlobaLearn's thrust leans heavily on great content and a great educational experience. Finally – a company is realizing the Web's potential. – *Julie Sullivan*

Trans-Asia Expedition: January through June. GlobaLearn Inc.: www.globalearn.org/.

JUST OUTTA BETA

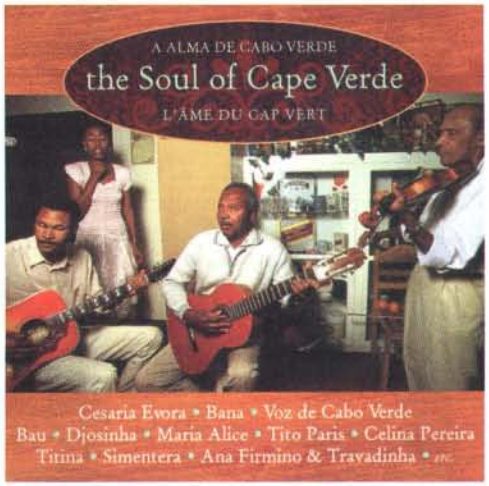
Various Artists

The Soul of Cape Verde

Tinder

Cape Verde is composed of 10 islands and a handful of islets located off the coast of Senegal. The Portuguese "discovered" the islands 540 years ago, then used them as a processing center for their African slave trade. People from many African cultures were brought to Cape Verde to supply free labor. Over the years, they intermarried with each other and the slave masters, producing a music that combines many European and African elements.

Cape Verde's musical styles include *funana*, an African folkloric music that sounds like a cousin of Brazil's *forró*; *coladeira*, Cape Verde's calypso; *samba-canção*, which mixes Brazilian samba with West African influences; and *morna*, a type of minor-key ballad that's been rediscovered through the international popularity of Cesaria Evora, Cape Verde's reigning world-music superstar. Evora's success has led to a resurgence of musical pride in the region. Bands that were playing covers of European dance



music years ago have returned to their roots, a movement chronicled on this excellent compilation.

The long Portuguese occupation has left its imprint on the morna, a style that at times can sound like arty European cabaret music. Evora opens the set with "Papa Joachin Paris," a melancholy morna in the traditional mode, but other artists add their own unique touches – Djosinha's "Partida" moves to a tango-ish backbeat, while Chico Serra's keyboard arpeggios make "Fidjo Maguado" feel like a bluesy flamenco waltz.

The Brazilian connection lends the coladeira an upbeat yet relaxing tempo: Bana's "Serpentina" sounds like a samba played by an African klezmer outfit, while "Cutch Cutch," by Amandio Cabral, has an energetic soca flavor and a strong vocal hook.

There are also a few percussion-heavy tracks that sound more typically "African," including Celina Pereira's "Saude," a traditional samba-canção with a rippling drumbeat and lush call-and-response vocal, and Teofilo Chantre's "Pais di Mel," a bouncy samba with a hint of zouk. – *j. poet*

The Jon Spencer Blues Explosion

Now I Got Worry

Matador

The Blues Explosion's long-awaited follow-up *to Orange* is a chaotic, noisy mess of an album. It's also one of the most compelling records of the year, as the band chases the darker side of the blues idiom as far as it can go. Unlike its predecessor, *Worry* never quite settles into a funky Delta groove, instead careening from blues to hardcore to rap, finally opting for a Sun Sessions-on-bad-acid vibe. This uptight, claustrophobic feeling sustains the album, Judah Bauer's overheated guitar shoved to the front of the mix with Spencer's shuddering howl. *Awwwwww, yeah!* – *Jeff Baskin*

Howie B.

Music for Babies

Island Independent

Noted for relationships with Brian Eno and U2, Howie Bernstein, as they say, got juice. Also a guest on the *Passengers* CD, Mr. B. parlays newfound clout into a cool, conceptual tone poem, a disc inspired by the birth of his daughter and one that exceeds the conventional confines of modern electronic composition. While his debt to Eno is conspicuous, this is closer in spirit to Miles Davis's *In a Silent Way* than to *Music for Airports*. Suspended ambient dreamscapes frosted with imperial jazz grooves are lovingly ministered with a new parent's touch. More evidence that modern DJs can be real musicians. – *Mitch Myers*

Various Artists

The Future Sound of Jazz

Instinct

If you come across this disc in the jazz section, notify the proper authorities immediately, though it's essentially the spirit of jazz – improvisation, radical innovation, and rich moods – that lives within this collection of pioneering underground electronic tracks. There are more literal connections here than clever marketing: the intricate and frenetic programming in junglized "Sexual Attraction" and "All That Jazz" recalls hot and heavy jazz drum solos, and µ-ZIQ's "Hector's House" busts dance music conventions just as bebop did 40 years ago. *The Future Sound of Jazz* is bold and expansive – a bit like jazz, really. – *Scott Taves*

Steve Roach, Stephen Kent, Kenneth Newby

Halcyon Days

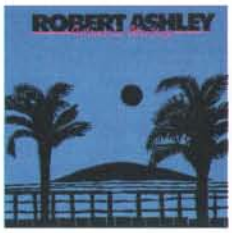
Fathom

With synth-washed pieces and a fealty to ancient native traditions, the prolific Roach teams with Trance Mission members Newby and Kent to realize the didgeridoo. Kent is a master of the aboriginal dronepipe, and Newby's drums and flutes add global color. Roach's space-attuned electronica works especially well here, alternately invoking Tangerine Dream and suggesting the restless hibernation of giant beasts. The didge's recent abuse in techno-ambient farragoes is distressing, but *Halcyon Days* rescues it from dance-floor stupefaction. – *Alan E. Rapp*

Robert Ashley

Automatic Writing

Lovely Music



Based on the study of a patient with a mild case of Tourette's syndrome, "Automatic Writing" is a most mysterious work, one of several on this disc. Hallucinogenic female whispers mix with involuntary speech in textless utterances, mumbling and moaning within a clipped, electronically altered sonic envelope. Vocal parts are layered with faint electric drones alongside a peculiar, slightly disturbing sound, something like lightly tapped tin cans. Over the course of 46 minutes, the effect is dreamlike, even nightmarish, the analog to David Lynch's most experimental film work. Fascinating listening. – *Dean Suzuki*

Baby Fox

A Normal Family

Roadrunner

It's easy to see how Baby Fox got entrenched in Jamaican grooves, given the band members' reverence for Lee "Scratch" Perry (whom they consider a shaman). Roll these three North Londoners in the heavy cultural influences of their own Kingston-on-Thames, sprinkle into the mix Christine Ann Leach's seven-star Metaxa vocal style, and inhale deeply. The result is a smooth and soothing buzz, a bubble of aural fantasy, addictive as nicotine and slippery as a plantain peel. If the trip-hoppy, mellifluous melodies of Portishead come to mind when you spin *A Normal Family*, blame the zeitgeist. – *Jennie Ruggles*

Various Artists

Fallen Angels

EMI/Taiwan

The soundtracks to Hong Kong director Wong Kar-Wai's movies are as moody, playful, and cross-culturally hip as the imagery with which they're coupled. The music accompanying his latest – a dreamy, violent sequel to *Chungking Express* – emanates cosmopolitan cool with cuts that lay down beats for the enigmatic characters in his neon nightscapes. Bass-inflected trip-hop and erotic, synthcentric tracks are rapped and whispered in French, English, and Mandarin. While the film has yet to arrive in multiplexes, the music is available in Chinatown shops and specialty stores. Worth the search. – *Wagner James Au*

The Chrome Cranks

Love in Exile

PCP Entertainment

Few bands do mayhem like Cincinnati's Chrome Cranks, which is why the attempted stylishness of their third album comes as something of a surprise. "Movie Star," for instance, is nigh impressionistic, with drummer Bob Bert thumping out a faint heartbeat while generally unhinged frontman Peter Aaron plays it so cool he barely registers. But hold your Bronx cheers, trash collectors: "Wrong Number" and "Down for the Hit" still sound utterly incorrigible, as the Cranks continue to deliver music that kicks like a boot in the belly of a drunk in the gutter. Happy freakin' New Year. – *James Sullivan*

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Polar can help adjust your workout, but I don't advise pouring ice water down your bare chest – that's a shock to the heart. – *Chris Rubin*

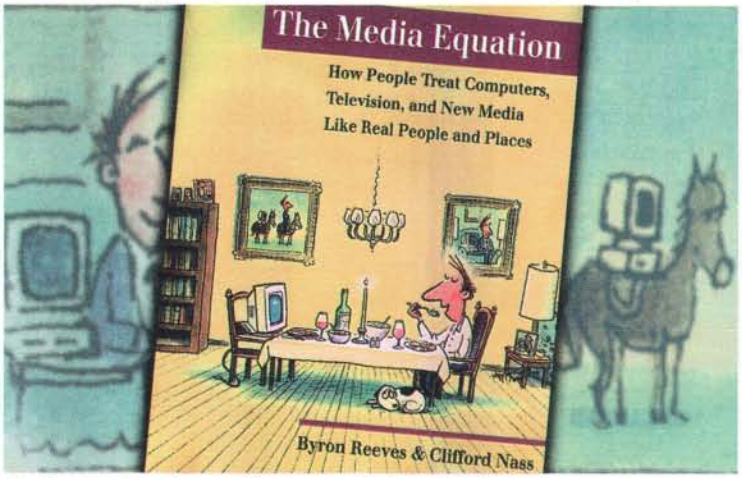
Polar Vantage Night Vision Heart Rate Monitor: US$399. Computer interface and software: $389. Polar: (800) 227 1314, +1 (516) 484 2400.

Romancing the Media

Only a gullible newbie would be fooled into thinking a computer was an actual intelligence, right? Wrong. During years of research at the Center for the Study of Language and Information, Byron Reeves and Clifford Nass discovered that even computer scientists and engineers treat their creations as human. And we don't just do this with computers – we anthropomorphize objects such as books and two-dimensional graphics.

This mind-boggling fact has innumerable practical applications. Nass and Reeves's book, *The Media Equation*, provides insights into crafting convivial computer interfaces that please users and blend into daily life. For interactive media designers, the cogent guidelines contained in each chapter are invaluable.

This book goes far beyond how to build polite gizmos, however. It seems our social instincts lead us to make the same conservative error when faced with media and artifacts: When in doubt, treat it as human. As the authors put it, "Any medium that is close enough will get human



"Pardon me, Mac, but could you pass the cheese loaf?"

treatment even though people know it's foolish and even though they likely will deny it afterward."

The social implications of this fact in a world populated by an ever-growing number of machines are made all the more unnerving by example after example from recent history. We all laughed when a group of Iraqi soldiers surrendered to an unmanned aerial drone during the Gulf War, but it seems that we all surrender in similar, albeit more subtle ways in our day-to-day lives – to our TV sets, our appliances, even print media like this magazine. If we are so inclined in an age of still-dumb machines, god help us as our artifacts become yet more engaging and autonomous. By making this human tendency explicit, *The Media Equation* might just help inoculate us against the inclination to credulously anthropomorphize our inventions to come. – *Paul Saffo*

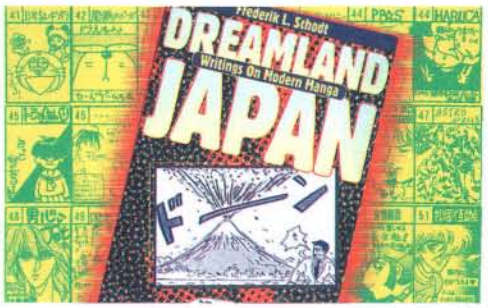
The Media Equation: How People Treat Computers, Televisions, and New Media Like Real People and Places, by Byron Reeves and Clifford Nass: US$27.95. CSLI Publications, Cambridge University Press: +1 (212) 924 3900.

Japan's Dreaming

The Tokyo subway at rush hour: strangers' bodies press against one another. A psychological border envelopes each person. High school students and thirtysomething salarymen pore over the same pulpy publications – the ubiquitous manga.

Manga, Japanese comics printed on low-grade recycled paper, cover all aspects of culture, from historical samurai stories to social satire. In many respects, Western comics and manga have about as much in common as Dave Barry and Thomas Pynchon. And like the work of Pynchon, manga aren't typically a direct representation of reality, but rather a rich, streamlined pictorial language.

Frederik Schodt's book opens the door to this reality for *otaku* (fans) and novices alike. Combining an insider's knowledge of Japanese culture with an objective *gaijin* (outsider) perspective, *Dreamland Japan* is a comprehensive guide to understanding the nuances of Japan's dominant pulp pop form.



An explosive look at pulp pop.

The book's breadth is panoramic. Led by his fascination with the medium, Schodt discovers and introduces us to some of Japan's greatest manga creators. In one section, for example, we read of Shingo Iguchi's *Z-Chan*, an artful but enigmatic comic featuring a boy in a dunce cap. After Schodt meets Iguchi, he is finally able to unlock the internal logic of its universe.

Dozens of other artists are profiled, including Osamu Tezuka, whose groundbreaking "cinematic techniques" (close-ups, extreme perspectives, and progressive frames) influenced generations of subsequent artists.

Thanks to *Dreamland Japan*, we can enter the inner space of the Japanese psyche – without the subway crush. – *John S. Couch*

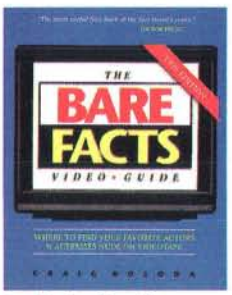
Dreamland Japan: Writings on Modern Manga, by Frederik L. Schodt: US$16.95. Stone Bridge Press: +1 (510) 524 8732, on the Web at *www.stonebridge.com/dreamland.html*.

Naked Obsession

Kinky yet poignant, Craig Hosoda's *The Bare Facts Video Guide* often captures the attempts of struggling young actors to get noticed.

Hosoda has made it his life's work to watch as many videos as possible, logging every flickering glimpse of breast, backside, and brief frontal nudity. And thank Blockbuster he has. Now I know that the hottest shot of Harry Dean Stanton available on video appears one hour into his 1971 movie *Cisco Pike*. For the wildest moment, the viewer is treated to an upper-buns shot as Stanton rises from the bath to greet Kris Kristofferson. The lucky bastard.

Not just for those who hunger for thespian flesh, Hosoda's *Guide* is a work of total seriousness and gravity. While working on *Howard the Duck*, Hosoda, a respected software engineer and ex-Industrial Light & Magic programmer, discovered that his friend Marty had no knowledge of Lea Thompson's nude scene in *All the Right Moves*. There should be a book that lists this type of important information in one place, he thought. And you know how it goes – what starts as a philanthropic hobby can result in your leaving a prestigious job in movie production to become a full-time dirty Leonard Maltin. – *Jamie Cason*



In-the-buff guide.

The Bare Facts Video Guide, by Craig Hosoda: US$19.95. Self-published: +1 (408) 249 2021.

READ ME *On the bookshelves of the digerati*

PAMELA MCCORDUCK *is the author of eight books; her latest is* The Futures of Women: Scenarios for the 21st Century.

***The Complete Stories,* by Flannery O'Connor.** "I just reread these stories, which were written in the '40s and '50s. We think of this as a tranquil time in the US, yet there is an undercurrent of violence – not spectacular violence, not violence that makes statistics, but quiet violence that's hidden. It's clear that violence has been a constant in our history. Between parents and children, and husbands and wives, it crops up again and again in her work. The stories are really distressing to read – I can do about two a night and then I have to put the book down."

***Sor Juana,* by Octavio Paz.** "I'm reading this very slowly and finding it absolutely riveting. Though it's more scholarly than poetic, it's still beautifully written in Paz's sublime voice. On one level, this is the story of one poet's struggle to find her voice. But it's also the struggle of a colony to find its voice, of indigenous people to survive imperialism, and of women versus the Catholic church. In some ways the struggles of women in 1590 are not so different from the those of women in 1996."

PAUL SAFFO, *director of the Institute for the Future, is waiting for Gary Snyder's newest book,* Mountains and Rivers without End.

***Ralph 124C41+: A Romance of the Year 2660,* by Hugo Ralph Gernsback.** "*Ralph* began as a serialized piece in *Modern Electronics* in April 1911. This is a fascinating chronicle of expectation in more technologically optimistic and innocent times. And it was remarkably prescient, although Gernsback does see some things – such as 3-D TV – happening far more quickly, and other things occurring far more slowly – he imagines the last New York harness horse dying in 2096."

***Capitalism, Socialism, and Democracy,* by Joseph Schumpeter.** "This classic is more relevant than ever because Schumpeter's notions about the economic impact of technological change nicely mesh with current events. Despite both an affection for Marx and an underestimation of the impact of entrepreneurial innovation, Schumpeter may just replace Keynes as the theoretical godfather of economics in a digital age."

Pamela McCorduck

Paul Saffo

Robert Ellis Smith

ROBERT ELLIS SMITH *has worked as a journalist and a lawyer. Now he publishes the* Privacy Journal *and tells people what their rights are.*

***Kolender v. Lawson,* by Justice Sandra Day O'Connor.** "This 1983 Supreme Court decision says that it's illegal for the government to stop people who are doing legal activities and demand identification. I am trying to oppose the FAA policy that airlines require ID before passengers can board an airplane. This brief was surprising in its brevity. Many of the decisions that protect our liberties the most are the shortest."

***The Sea, the Sea,* by Iris Murdoch.** "A retired actor purchases a seaside home and by coincidence all the people from his past show up in town. The plot has a mystique to it, though it is not a whodunit. I picked this book because of its skinny-dipping scenes. I'm working on an anthology of skinny-dipping scenes, which are obligatory in both American and British writing, especially in any man's biography. Murdoch is one of the few women to write such scenes."

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Gigabit Ethernet
According to conventional wisdom, Gigabit Ethernet is going to succeed where ATM failed. That's why it's so amusing to watch as Gigabit Ethernet developers make the same mistakes ATM developers were accused of. Too much hype? If you thought the Bell companies were bad, just listen to Andreas Bechtolsheim of Granite Systems. Standards that aren't really standard? Sure, there are some incompatible implementations of ATM, but Gigabit Ethernet vendors aren't even waiting for the IEEE to agree on a standard. Ethernet developers need to stop listening to Bob Metcalfe and start listening to George Santayana.

Object Resurgence
The most significant – if rather serendipitous – benefit of all the recent Java hype was that for a minute there nobody had time to talk about distributed objects. Pundits were too busy discussing the potential dangers of migrating code to slip in any mention of ORB, DCE, CORBA, OLE, or whatever the distributed object flavor of the month happened to be. Unfortunately, this brief intermission has ended, and the battle has resumed with no changes in opinions or combatants – only names. Now it's ActiveX instead of OLE, and JavaBeans instead of DOE.

This Month's Overhyped Memes	Hype Level	Position Last Month	Expected Lifetime
Gigabit Ethernet			7 months
Object Resurgence			4 months
Death of User Groups			2 months
Smartcards			10 months
Internet II			2 months

○ = Embryonic meme = Meme on the rise = Mass-media meme = About to die from overexposure

HYPE LIST

Death of User Groups
Everyone from reporters to industry gadflies professed shock and dismay when the Boston Computer Society voted to cease operation and shut its doors in September. But what was truly shocking was that a dinosaur like the BCS lasted as long as it did. Just as amateur radio groups quickly foundered when the medium became successful, computer hobbyist organizations became anachronisms as soon as industrial-strength support systems came into being.

Smartcards
After the Atlanta Olympics, where visitors successfully used Visa smartcards to make purchases, smartcard hype started in earnest. The clearest sign wasn't that possible buyers began to circle around the once-ailing smartcard developer SmartCash, or even that *The New York Times* published an article claiming that smartcards are insecure. No, it was Microsoft's announcement that future versions of Windows will be "smartcard aware." But watch out: Visa's trial in Atlanta may have been a qualified success, yet MasterCard's trial in Australia was a disaster.

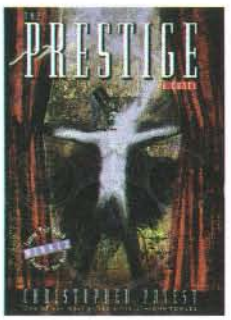
Internet II
The grand delusions of academia were starkly apparent when a consortium of 34 universities recently announced plans to create a new high-powered Internet, called Internet II. The idea that a few schools will be able to drive technology forward faster than today's commercial demand is blatantly ridiculous. But even more egregious is the delusion that universities need high-speed connectivity only to other universities, as if academia lives in its own, separate world. This is true only in one sense: Internet II participants are living in a dream world.

***– Steve G. Steinberg* (hype-list@wired.com)**

Tesla Foils

Stage magic has always gone hand in hand with technology. Magicians use the latest inventions both to build new illusions and to enhance the mood of a performance. Yet the essence of magic is still dependent on the simple human art of misdirection, and sometimes the most baffling effects are accomplished bare-handed.

Narrative deceptions permeate *The Prestige*, Christopher Priest's ambitious novel of two rival 19th-century stage magicians. The story is told primarily in the form of antique journal entries but reaches its climax in the present day, as the magicians' feud darkens the lives of their descendants.



Priest conducts magic.

The thematic focus of this eerie tale is on mysteries of identity, but the chief delight is an invention made by a cash-strapped Nikola Tesla for one of the rivals. Science masquerades as magic, with gruesome results. The scenes of Tesla at work in his Rocky Mountain laboratory are marvelous.

Even if you guess how Priest accomplishes his miracles, you are guaranteed to enjoy this brilliant conjuring act by one of the master illusionists of our time.
– *Marc Laidlaw*

The Prestige, by Christopher Priest: US$24.95. St. Martin's Press: (800) 221 7945, +1 (212) 674 5151.

Street Cred Contributors

Wagner James Au *(wjamesau@well.com)* is still searching – like everyone – for the soundtrack to *The Heroic Trio.*

Jeff Baskin *(jbaskin@cruzio.com)* is a writer and editor living in Santa Cruz, California. He is music editor of *Secret Nicole* magazine.

Peter Bosher is project manager of Information Superhighways at the Royal National Institute for the Blind, in England.

Jamie Cason *(nonet@s.yet.loser.co.uk)* is a comedian, philosopher, and bon viveur. His main influences are Henry VIII and Buddha.

John S. Couch, former liaison for *Wired* Japan, is associate producer of Wired TV.

Daniel Diver is a freelance journalist living in Germany. He heard a rumor that Kraftwerk might be reforming and is very excited about it.

Rob Dodson recently tunneled his way out of civil engineering and into the digital daylight.

Chris Hudak *(gametheory@aol.com)* writes for *Gamespot, Request, Video Game Advisor,* and *SOMA.* He really really really wants to meet Natalie Merchant.

Marc Laidlaw is the author of *Dad's Nuke, The 37th Mandala,* and the forthcoming *The Third Force: A Novel of Gadget.*

Mitch Meyers *(comeback@mcs.com)* is a psychologist and a freelance writer. He lives in Chicago and Manhattan and spends a lot of time on the phone.

Erika Milvy makes a career of criticizing other people's creative endeavors from her home in San Francisco. She has written for *Vanity Fair, Paper,* and *The New York Times.*

j poet *(poebeat@aol.com)* writes for *RhythmMusic, Utne Reader,* and many other fine publications. He is looking for a cheap, noncorporate online service.

Alan E. Rapp *(rappa@sfgate.com)* is a book publicist and pad thai aficionado. He sincerely believes that you have his best interests at heart.

Gabriel Ratcliffe *(gabe@never.com)* is an unemployed lawyer and onetime *Wired* editorial intern cum *Quake* fiend.

Chris Rubin often feels like exercising but usually sits down until the desire passes.

Jennie Ruggles *(jeneric@sirius.com)* once released a jar of fireflies she'd sneaked into a movie theater.

Paul Saffo *(psaffo@iftf.org)* is a research fellow at the Institute for the Future in Menlo Park, California.

James Sullivan *(onion65@aol.com)* is a regular contributor to a whole bunch of pop culture periodicals.

Dean Suzuki, PhD, teaches music at San Francisco State University. He is also a programmer at KPFA in Berkeley, California.

Scott Taves *(staves@interaccess.com)* is the US manager of B + W music and The Blue Room record labels and author of *A Pocket Tour of Games on the Internet.*

Rogier van Bakel *(rogiernl@aol.com),* as anagram enthusiasts will note, has Brave Ink Galore. He lives in Connecticut.

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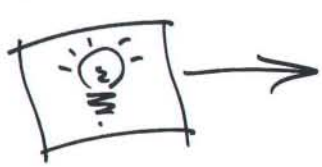

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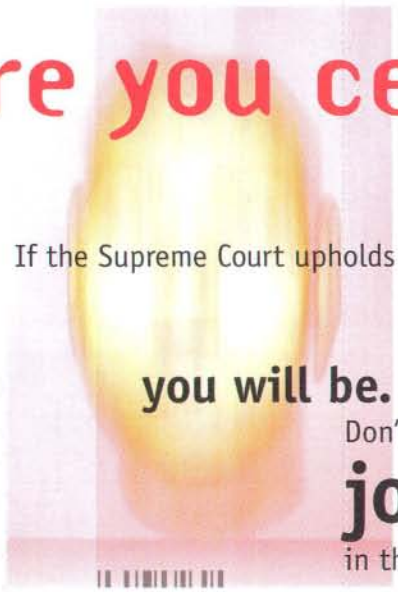

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net surf

Edited by Kristin Spence

Light, Air, and Literacy: *Salon* Continues the Dance

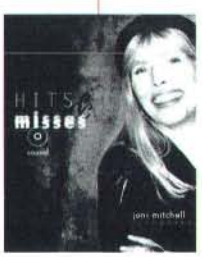
I was threatening to surf my last surf. I had had it up to here with technodweebs blabbering on in dweebspeak as if all the world were wired and the only things worth discussing were what's on the Internet and how many gigahertz and kilowatts you absolutely *have* to have if you don't want to become Roadkill on the Information Superhighway. Just when I was thinking that they've all lost the forest for the trees and wondering how come *I'm* the only one who remembers that the Internet was supposed to be a swell *tool* but just a *tool*, along comes *Salon*, the World Wide Web's only site that seems to grok this. Or, as David Talbot, one of the founders, puts it, "We are inspired by the creative potential of the Internet, but unlike many other Web sites, *Salon* is not a technocult. As refugees from the atrophying world of newspapers and magazines, our primary allegiance is to written communication, to the power of the word. We think of digital technology as an exciting means to an end, but not the end itself."

Sure, a lot's been written about this site already, but readership is up 30 percent and climbing, and *Salon* has just gone daily. We feel it bears mentioning that *Salon*, the first arts and culture e-zine to emphasize writing, has the smarts and finesse of *The New Yorker* and *Harper's* without the tree-killing. The design is stylish and refreshingly low tech, with charming illustrations instead of photographs and lots of white space. Edited by Talbot, *Salon* features an impressive array of writers who discuss matters of no technological consequence whatsoever. Past issues have featured the words and thoughts of Amy Tan, Shelby Steele, Camille Paglia, and Alexander Cockburn – who discuss the death of liberalism and the purpose of art, the demise of Hillary Clinton, Bosnia, *Seinfeld*, racism, Bruce Springsteen, and Newt Gingrich. Interviews and reviews abound alongside cartoons and mind twisters. There's a place to chat with people who have an actual life, and, yes (sigh), there is a place to spend money (you can buy many of the books and CD-ROMs by clicking an order in to Border's).

Salon has just been awarded Best Web Designers by the Cool Site of the Year people, and Talbot believes that *Salon* – while not a media juggernaut like Time-Warner – has made a name for itself because it doesn't rely on plug-in hoopla. "It's not a boys-and-their-toys site," stresses Talbot. "Bells and whistles are fine, but they're not what drives the Internet. Good content and interactivity are what drive the Internet." Furthermore, *Salon* offers the best discussion forum on the Web, according to Talbot, because it isn't a free-for-all. "There's no frat-house atmosphere," he says, pointing out that the level of discussion is more intelligent than most sites. One reason: its readership is equal parts male and female. The prevalence of women – as both browsers and writers – ensures a certain degree of quality and decorum.

With only a handful of sites out there that value substance over style, *Salon* is a breath of literate air in this computer-crazed world. – *Erika Milvy* (erika@well.com *and* www.goplay.com/961010/adv/movies/erika.html)

www.salon1999.com/

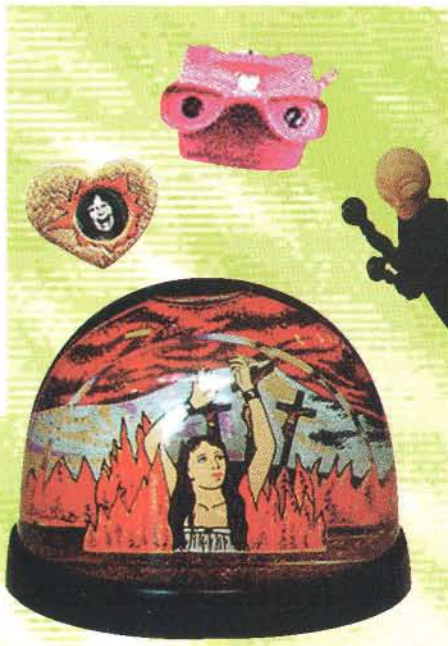


ZACH TRENHOLM

hatewatch.org/

Hated It!

Whoa! There are some wacked-out and hateful peeps out there. And the Harvard Law Library wants you to know it. Keeping a neighborhood watch on the Net, *The Harvard Law School Library's Guide to Hate Groups on the Internet* offers a glimpse of the sites that are deemed the most pernicious and dangerous on the Net today. Technically speaking, the site's pretty bland and devoid of any Java- or Shockwave-enabled visuals, but none of the horror is lost in translation: here you'll find links to revisionist, neo-Nazi, antigay, and Christian nationalist sites (the traditional baddies), as well as a few you might not expect – the Jewish Defense League, an anti-Christian group, and the Nation of Islam. Also featured are a clearinghouse of hate-watch groups worldwide. Don't miss the rundown of "white-power music" and supporting labels, the who's who of online hate, and the list of scholarly papers and articles about this chilling, flourishing phenomenon. You won't find all of the hate here, but, regardless, it's like planting your chin on Number Four sandpaper – a difficult education, yet an important one.



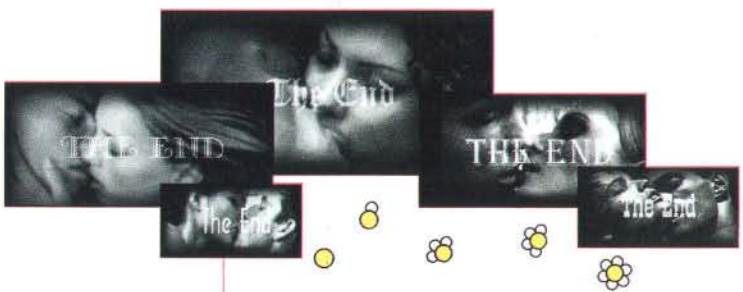
Shopping at the Speed of Kitsch

When aliens take over the Sherman Oaks Galleria, it will look exactly like *Shopper's Paradise*. GlamOrama transforms the act of shopping into a gleeful postmodern romp, dripping with pop culture icons, alien-abduction buzz, and some basic Shockwave gimmicks. The site deconstructs our fin de siècle obsessions and deftly reminds us that life is short, and, dammit, you need a Boxing Nun.

Exotic new technologies abound, including AutoDrink (stick out your tongue and receive a customized cocktail recipe), SnagOmatic shopping (see a tchotchke you like? Hit the Snag button and the details of your coveted item will be organized for later purchase activation, though your browser must support Magic Cookie technology), and fingerprint DNA scanning. (Determine your Alien Influence Quotient; who knows – you may be ripe for abduction!) Lush graphics and lots of clickable toys earn this site high marks for depth and good old-fashioned interactivity.

While visiting, don't miss the Blue Suede Room, WorldEye News, and the Online Wedding Chapel, where honest-to-God ceremonies are being performed *right now*. In a word: keeewwl.

www.glamorama.com/shop/welcome.cgi



Browse the Book of Love

Adaweb has introduced its latest Web art project, simply titled *LOVE*. Using Frames and Livescript (both downloadable from the site and supported by Netscape 2.0 and higher), LOVE presents a webbed maze of seven stories, each containing seven pages, told through images and words. Add your name and that of the one you love to the Love List, take a provocative peek inside of the mind of the Marquis de Sade, or witness love's many happy endings. Each story series is navigable in five directions (via arrows), making it an enjoyable challenge to view the site's 49 pages. Heterosexual love is most often represented here, but the group has taken care to acknowledge the homosexual community in the introduction.

adaweb.com/~adaweb/influx/GroupZ/index.html

Maximize your view pane and rev up your video subsystem (to a resolution of 1,024 by 768, if you've got it), but above all remember … as in real life, LOVE sometimes stops when you don't expect it to.

The Virginator

Sure, we all know the Pope and Mother Teresa are virgins, but a lesser-known fact comes from the Society for the Recapture of Virginity (or SRV): orgasms experienced by *recovered* virgins are 200 percent stronger than those of nonvirgins. SRV, along with Razorfish Productions, has unleashed the Virgin Recovery System, or VRS 3000 – an Internet product that enables even the most Don Juanesque among us to experience that fresh-flower innocence of virginity, again and again and again. After entering your stats into the revolutionary VRS 3000 (including the exact sound you heard while making that first whoopee), *bam!* It's like it never happened.

While you reformed Casanovas and Madonnas may not be able to hold your virginity in your hands, you will be able to fondle the personalized certificate sent to you by SRV, as well as wear the Get It Back badge of pride.

"Close friends think I lost weight or got my hair cut. They can't tell what's different. It's my little secret," boasts a satisfied user. So go on – get it *back*!

www.razorfish.com/bluedot/srv/

The Ore of Urban Folklore

Richard Gere's gerbil? Walt Disney's frozen corpse?

Like the stories it enshrines, *The Urban Legends Archive* is just a little too good to be true. Several classics are here, and a few interesting facts can be found out with some authority. But there's no graphic appeal whatsoever, and many accounts peter off into bibliographies (yawn), state laws (zzz), or even federal regulations (she's flatlining!).

And yet, as with any good car crash, it's difficult to look away. The promise of a truly breathtaking legend overcomes the uninspired packaging. You just have to check under that next heading. You just … have … to know …

www.urbanlegends.com/

Where Do You Want to Go Today?

Here's a great way to roam the world right from your dingy little veal-fattening pen. Wanna check the windsurfers on Maui's north shore? Get a bird's-eye view of Paris, Chicago, or San Francisco? How about simply having a good laugh at those poor fools kvetching in their cars as they inch their way across the George Washington Bridge at rush hour? Whatever your pleasure, just point your browser to a WebCam clearinghouse such as the *EarthCam* site or the more pedestrian *Leonard's Cam World (www.leonardsworlds.com /camera.html)*. We recommend a jaunt to the telerobot site in Perth where you can mirthfully watch as you pick up or knock down blocks with a robotic arm *(telerobot.mech.uwa.edu.au/cgi-win /telerobt.exe)*. You'll be amazed what an infinitesimal act of destruction in a place thousands of miles away where it's already tomorrow can do for you. Better than Bob!

www.earthcam.com/

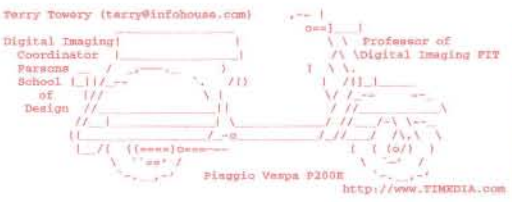
As Permanent as an Electron

There's this great thing about the Net: just when you think you've seen it all, up pops something like *Virtual Memorials*. What greets you on the opening page seems like a poor man's *Myst* – an image of rolling green hills under a deep blue sky is tucked within the pages of an open, dusty volume that's bookmarked with a long-stemmed rose. (Heh. Your Monty Python mind will embellish it with digitized images of dead people lying in coffins and fending off gargantuan hedgehogs.) Even so, you'll be surprised. The memorials are tastefully done – they're even respectful.

virtual-memorials.com/

Random ASCII Art o' the Month

```
Terry Towery (terry@infohouse.com)
Digital Imaging Coordinator
Parsons School of Design
```



Piaggio Vespa P200E

http://www.TIMEDIA.com

Thanks to the *Wired* 5.01 Surf Team

Colin J. Lingle *cjlingle@seanet.net*
John Makulowich *john@trainer.com*
Sean Makulowich *makulow@cais.cais.com*
Marissa Raderman *maraderman@aol.com*
Ted Roberts *ted@wired.com*

Seeking...

purists

& hybrids

Industrial Design

Interaction Design

Environments

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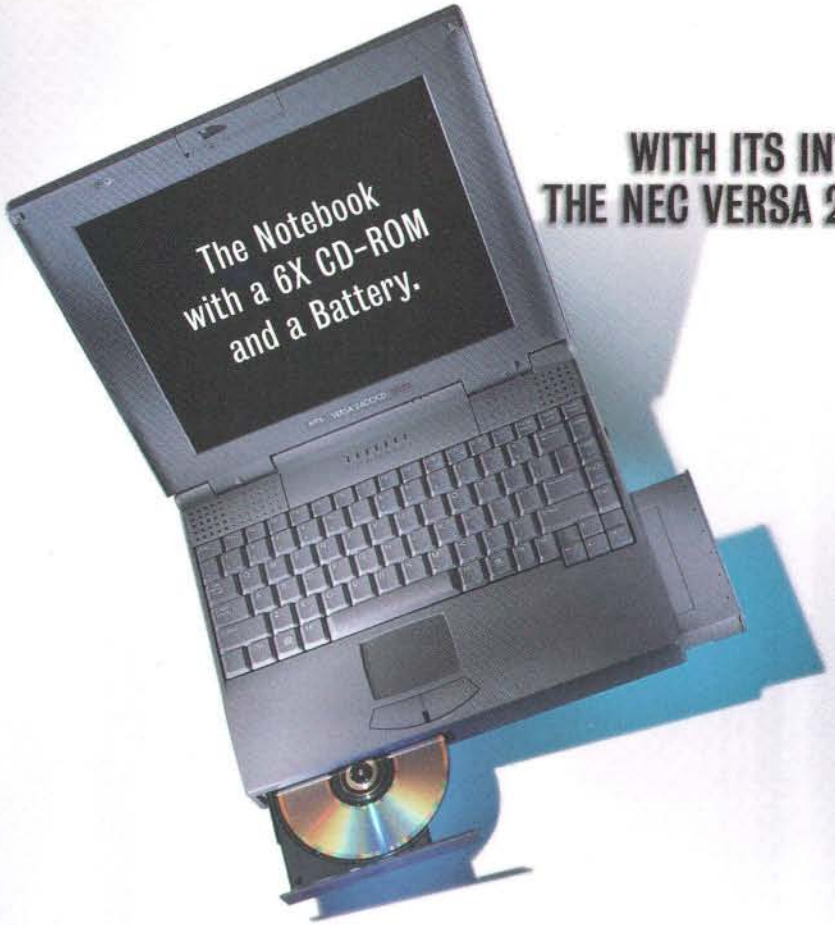
IDEO



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*Two VersaBay slots***
Two high-output stereo speakers
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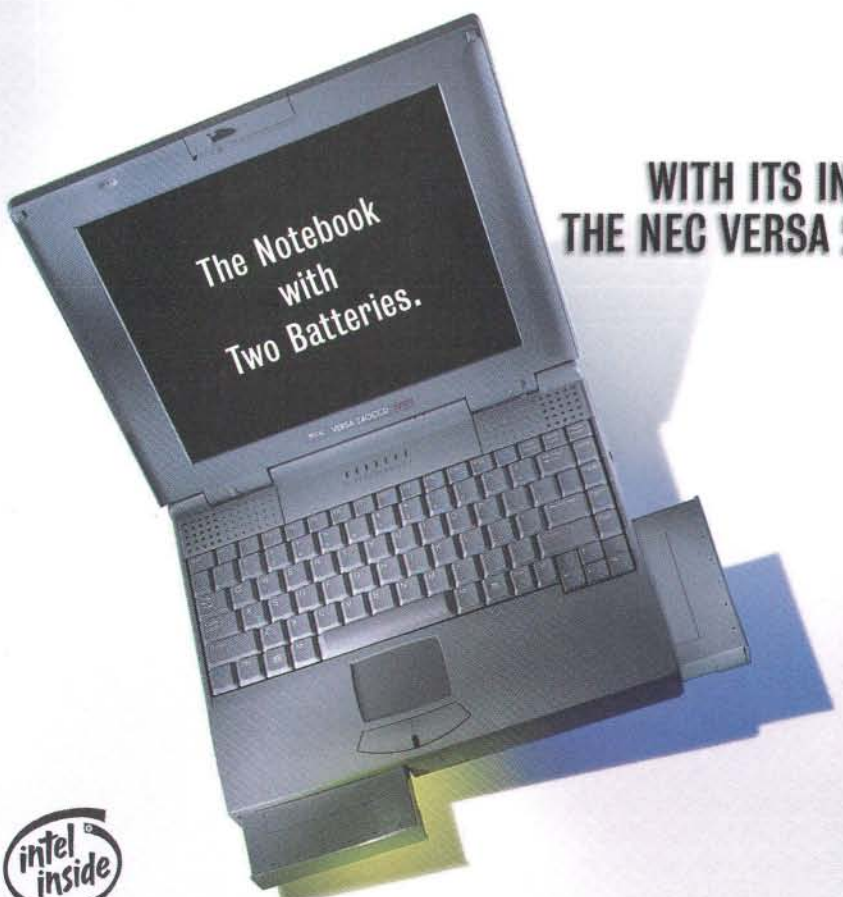

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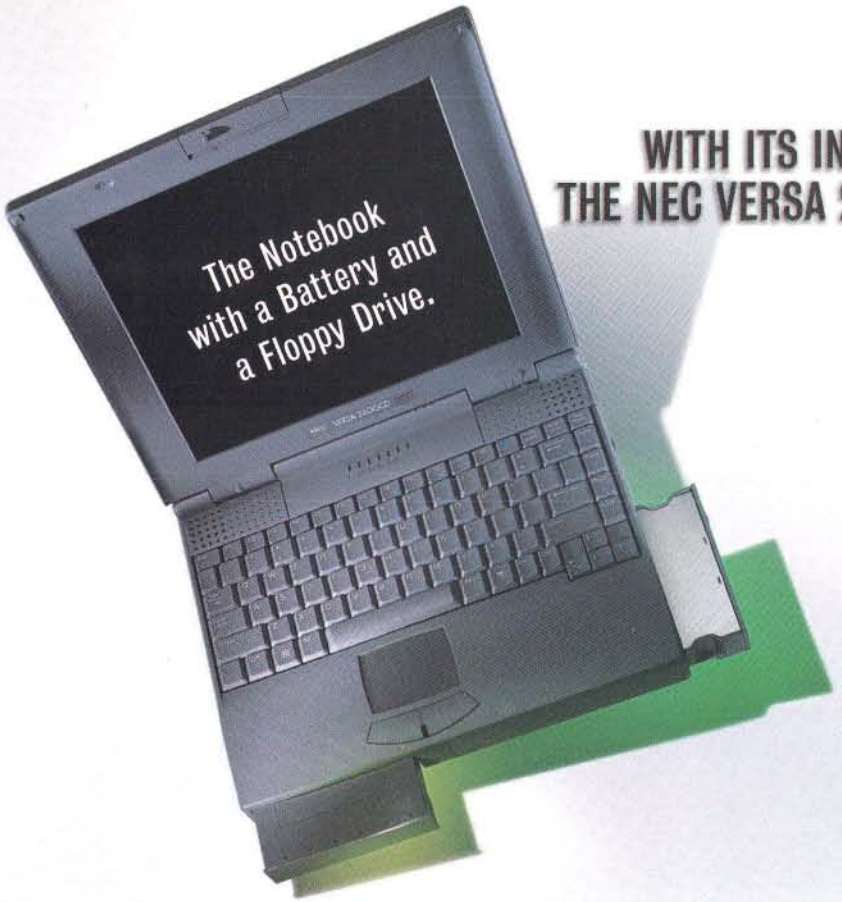

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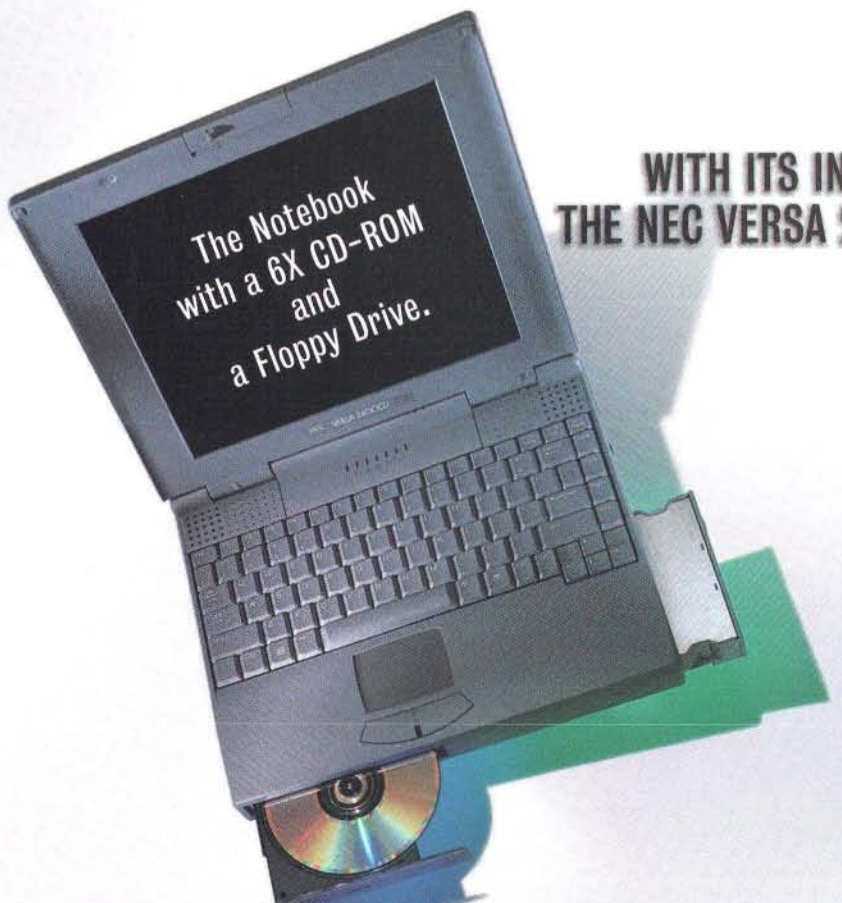

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Two high-output stereo speakers
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◂ 56 relented and within hours put the contested documents back. Kletz got some useful mileage. "We were handling more than 100 hits per second," he says proudly. But then came the Oliver Stone touch: the morning after, someone hacked Insignia's Web site, erasing not just the famous documents, but hundreds of new orders for *Gassed in the Gulf*. Whodunit? "No evidence," Kletz says, "except that it was probably not a casual effort."

Not all Web-based news acquires that kind of extradigital life. Other than Lamar Hunt's 15-minutes-of-fame online declaration of his candidacy for president – and maybe one or two of the swarm of "unofficial" parody sites – it's hard to think of anything of significance in campaign 1996 that played out on the Net. Contrast that with television's billion-dollar slugfest. As Esther Dyson points out, in this new medium, propaganda simply falls flat.

What works much better is a category of news that is spilling into – and out of – the Net with a velocity that's probably directly proportional to the number of people, and news outlets, coming online. It's often news that is so hotly disputed (or in some cases, disputable) that the continued retransmission and discussion quickly give it a life of its own – one that may say more about the people passing it on than about the original source. It is, in short, paranoid news. News you can abuse.

That's what some people say *The San Jose Mercury News* was doing when it splashed a three-part series in late August, detailing, as a dramatic prolog put it, "how a San Francisco Bay Area drug ring sold tons of cocaine to the street gangs of South-Central Los Angeles in the 1980s, sending some of the millions in profits to the Contras, a Latin American guerrilla army run by the U.S. Central Intelligence Agency." The story was simultaneously uploaded to the Mercury Center Web site *(www.sjmercury.com/drugs)*, one of the first and busiest newspaper sites on the Net – it is Silicon Valley's hometown newspaper, after all. Headlined "Dark Alliance: The Story Behind the Crack Explosion," the series caused an immediate uproar, especially among black Americans eager for some explanation of the long-standing scourge of the country's inner cities. The furor was not exactly an accident: as they often do with hot stories, Merc Center staffers diligently posted electronic teasers for the series across Usenet, including alt.conspiracy, alt.politics.org.cia, soc.culture.african.american, and, for good measure, the always busy alt.current.events.clinton.whitewater. Back again to the president's nose.

To call "Dark Alliance" paranoid news is not necessarily to question the imprimatur of its source. The *Mercury News*, after all, is not some fly-by-night webzine run by journalists with microscopic CVs and a lust for tall dollars. It's a Pulitzer-winning bulwark of the decidedly mainstream Knight-Ridder chain, the biggest and arguably best paper in the Bay area. And indeed, at least before "Dark Alliance" came under withering fire from its even bigger-gun competitors, *Merc* editors admit the word *Pulitzer* floated before their eyes.

Paranoid news isn't just about hype and unfounded conspiracy theories. It's also a reflection of bigger things going on, both on the Net and in society as a whole.

But you didn't need to be William Casey's ghost to notice that the online version of "Dark Alliance" was deliberately hyped, including the made-for-TV title – widely mispresumed to be the supposed operation's code name – and an opening-screen graphic (quickly yanked under fire from critics) that had a photo of a man smoking crack superimposed over the CIA's logo. Along with a trove of clickable supporting documents (selectively edited, the paper later admitted), the Merc Center helpfully provided busy discussion groups and live chat shows, with reporter Gary Webb jumping in to stoke the fires. Outraged black radio talk-show hosts – some of whom read downloaded copies of the "Dark Alliance" over the air – pushed the story over the top, and three separate official investigations were quickly ordered in Washington. The "Dark Alliance" site eventually acquired a strange front-page warning label: "The series never reported direct CIA involvement, although many readers drew that conclusion." But it certainly touched a live wire – and not coincidentally, pushed up the Merc Center's daily traffic by 100,000 hits, including its most active day ever.

The irony, of course, is that behind all the shouting, serious work was, and is, being done online. Slipstreaming on "Dark Alliance," *The Consortium* – "the Internet's first investigative zine" *(www.delve.com/consort.html)*, launched last year by veteran Washington reporter Robert Parry – began posting its own periodic updates, including one that said Massachusetts governor Bill Weld, then in the midst of a heated race for US Senate, had "stonewalled Contra-cocaine allegations" when he was chief of the Justice Department's criminal division a decade ago. Parry, who also directs *The Nation*'s investigative unit, states the obvious: The Net gives him a unique chance to "use traditional journalistic standards and solid documentary evidence to produce investigative stories on important issues that the mainstream press downplays or ignores."

So let me be clear: paranoid news, considered an extension of Hofstadter's paranoid style in politics, isn't only about hype and unfounded conspiracy theories. It's also a reflection of bigger things going on, both on the Net and in society. Indeed, a little paranoia may not be a bad thing, especially if you believe that the surge in Net-based news presages a sea change in American democracy. If garbage doesn't swamp legitimate stories, the Net could conceivably restore real meaning to the concept of civic vigilance.

Paranoid news is compelling in part because it turns ultimately not on *truth* but on complex matters of belief and self-identification. Believe it or don't – maybe O. J. Simpson is guilty, maybe he isn't – but what *you* think probably says something about your experiences with race, racism, and the police. Lee Harvey Oswald acted alone, or he didn't – but what *you* think probably says something about how much you trust the government and the ruling class. "Dark Alliance" struck a chord with old-line CIA foes, but its

driving force came from black Americans: *someone* has to be behind the plague decimating inner-city youth.

Trust is one of those metaphysical concepts the Web has already thrown into high relief. Am I chatting with a man or a woman? A person or a bot? Most netizens are already well aware of the problem: the medium itself isn't geared – right now, anyway – for easy verification. One can agree, to paraphrase free speech advocates, that the best antidote to bad information is more information. But amid the surfeit of potentially dubious data, a lot of people learn very quickly to be unselfconsciously, even involuntarily, suspicious. Because the bar for presenting things honestly on the Web is pitifully low, suspicion is very nearly hardwired into the nature of netizenship.

It's always worth pointing out that the Net hardly invented bad information. Back in the Second Wave media world, public service outfits like Project Censored, Essential Information, and Fairness and Accuracy in Reporting beat their collective brains out every year trying to draw attention to flagrant distortions, hypocrisies, conflicts of interest, and deliberate omissions in TV and print journalism. They don't even waste their time with the *National Enquirer* – let alone *Area 51 Digest*. Yet all such organizations together do little more than shatter a few windows in a veritable Sears Tower of media cynicism.

It's always worth pointing out that the Net hardly invented bad information. But there's also not much question that it opens up new horizons for hype and opportunism.

There's not much question that the Net opens up new horizons for hype and opportunism. It's still in the early days, and no one knows for sure which sensational Net-borne story is going to set off the right bells and whistles and follow "Dark Alliance" into the national headlines. It's a sure bet, though, that a lot of people are staying up late trying to figure that out – and not just in basements.

Now that virtually all major American newspapers are online, they are all, willynilly, national newspapers. In fact, they're global. And in a very real sense – hit counts and advertising dollars – they're competing for readers. All readers, everywhere. That's a novelty, coming out of an age of fat, bland monopoly newspapers, and an unsettling one at that. Worse, the Net's TV-like qualities – which will only increase – make it ideal for spectacular "revelations" and melodrama. In other words, newspaper-level density of information, as presented by Your Eyewitness News Team. Or two clever kids in a garage. That could still be good news: like in the movie *The Front Page*, "scoops" and banner headlines are how hard-charging newcomers to the news business move up. But for anyone interested in pure truth, the result isn't necessarily edifying.

What uniquely drives much of Net-based news, though, is something less palpable: the brute passion of people, filling email in-boxes and Usenet's tribal bulletin boards, often with posts that don't say much more than "FYI" or "Hi, I'm here." Anthropologist Bronislaw Malinowski calls this *phatic communication* – the social grunts and greetings that compose much of daily intercourse with fellow human beings. In the real world, phatic communication can be as simple as sharing a grimace with a stranger when someone cuts in line at the grocery checkout. Online, though, unless you're still one of those foppish few who are still using emoticons, phatic gestures are more often things like "Thought you'd enjoy this" or just "FWD." Being social literally means "spreading the word."

The question that begs, of course, is what happens when the Net moves out of its current toddler stage – when 90 percent of Americans, instead of barely 12, are online? When instead of a couple of strange emails a week, it's a dozen (or a hundred) a day? And when the Net has all the bells and whistles of television – in fact, it *is* television – and you've got the Oliver Stone channel coming at you, 24 hours a day? It may not be that far off – look what's hot in prime-time television: shows like *Millennium*, *Profiler*, and *Dark Skies* with plot lines straight out of the deep end of alt.conspiracy. Yahoo! lists 405 *X-Files* Web sites. How long before some bright-eyed, would-be media mogul starts offering a special *X-Files* "news service"?

Perhaps there will come a point of crisis – a crisis of confidence, if not conscience – when all those who are having fun with the Kooks Museums and Skeleton Closets and Area 51 sites wake up. After all, when everyone is getting their own news and no one's getting the same news, it doesn't do much for consensus. This may be the moment when we collectively agree on the need to find some way to separate information from entertainment. How many parents really want their kids to study the movie *JFK* or *The Turner Diaries* in history class? Or Orlin Grabbe's homepage in current events? Maybe this should be a policy issue, in the synergistic universe of what *The Nation* has dubbed the "national entertainment state." Oliver Stone can chair the committee.

The problem, of course, is that a lot of people *like* things that fit their reality – in fact, the closer, the better. And the Net is more than happy to oblige. "People who aren't looking for truth but for confirmation will find it," Dyson rues. To flip that around, we've all got our versions of Ernest Hemingway's "bullshit detector," a personal reality compass. Normally, it works online, too. "If what someone tells you is remotely close to the truth as you know it," says Dyson, "that will be a sign of reliability on other matters." Net developers call it branding. In English: trust.

Anatole Broyard, the late *New York Times* book reviewer, once wrote, only half in jest: "Paranoids are the only ones who notice things anymore." The Net gives them 20/20 vision – more like infinitely powerful binoculars, in fact. That's not necessarily bad, especially if and when everyone becomes more or less equally wired – at least we'll all be talking about the same universe of data. "For all its shortcomings," says Parry, "the Internet can't do much worse than the mainstream media have. It might even help Americans discover information in a more democratic fashion. Let's hope." ■ ■ ■

◄ 125 without anything else besides visible speech," says Dominic Massaro, a professor in the department of psychology at the University of California, Santa Cruz. "Unfortunately, a lot of them don't really get everything that is coming by."

In any event, work in computer lipreading – or rather speechreading, since the computer looks at the person's jaw, tongue, and teeth as well as the lips – has been steadily progressing for more than six years. David Stork is one of the principal researchers in the field.

Why speech-read? To assist with voice recognition, explains Stork. It turns out that combining vision with sound can help a program to disambiguate two words that sound similar but look different when they are spoken, like "me" and "knee." "Speechreading promises to help for those utterances where acoustic recognition needs it most," he explains.

Pure speechreading is probably unrealistic. But within 10 years computers will likely get the gist of a conversation without sound.

But even assisted speechreading is still in its infancy. Researchers estimate that it will be more than 10 years before commercial speech-recognition systems use videocameras to improve their accuracy.

Bottom line: Clarke was probably right – pure speechreading is probably unrealistic. Within 10 years computers will likely progress to the point where they can get the gist of a conversation by speechreading.

Speak to me

From the moment HAL utters his first words, it is clear to the moviegoer that the 9000 series is a superior architecture: HAL's voice is decidedly nonmechanical.

For Kubrick, creating HAL's voice was easy. Kubrick simply handed a script containing HAL's words to Douglass Rain, a Shakespearean actor now based in Ontario, Canada, and asked him to read the words into a tape recorder. It took Rain a day and a half. (Three decades later, HAL remains Rain's most memorable role. Perhaps for that reason, the actor refuses to discuss HAL or the film with the press.)

After nearly a century's research by scientists trying to produce synthetic speech, Kubrick's technique still dominates the industry. Most games that have "computer voices," for example, actually use digitized human speech that has been electronically processed to make it sound more machine-like. Likewise, most computers that speak over the telephone construct what they are trying to say by pasting together phrases from hours of recorded human speech.

Prerecorded, cut-and-pasted speech works only when there is a limited stock of phrases. But when you need an unlimited collection of phrases and sentences, the only way to produce a computer voice is with synthesized speech.

The biggest users of synthetic speech are the blind. For example, blind people could have this article read to them by DECtalk, a speech synthesizer from Digital Equipment Corporation. More than 10 years old, DECtalk is still one of the best-sounding voice synthesizers on the market. Others could listen to this article on their Macintosh: Apple's System 7.5 comes with a speech synthesizer called MacinTalk; an even better synthesizer, MacinTalk Pro, can be downloaded from the company's Web site.

Listen to HAL's voice and you'll discover why synthesizing speech is such a hard job. Despite being told to read the words in an emotionless monotone, Rain nevertheless crafted minute timing modulations, pitch shifts, and amplitude changes into the words as he said them. That's because the actor understood the meaning behind the words, and part of that understanding was encoded into those minor variations. He couldn't help himself.

"As the field has been maturing, we are realizing that you can't treat a speech synthesizer the way you treat an old-style line printer," says Kim Silverman, Apple's principal research scientist for speech synthesis. "The way you say something depends on what it means, why you are saying it, and how it relates to what the listener already knows."

As a result, much of the research on speech synthesis today has turned into research on understanding natural languages. Joe Olive, department head of text-to-speech research at Bell Labs, explains it this way: "If you just talk, it is a lot easier than if you have to read aloud something that somebody else wrote. The reason is that when you are talking, you know what you want to say."

Bottom line: Today's computers speak pretty well when they operate within narrow parameters of phrases, but sound mechanical when faced with unrestricted English text. Real breakthroughs will require a better understanding of natural language. Give it five years.

The vision thing

The HAL 9000 comes equipped with a general-purpose video system that follows Poole and Bowman around *Discovery*. When Poole goes on his space walk to replace the AE-35 unit, HAL presumably uses his vision to guide the pod's robotic arm and sever the spacesuit's air hose.

"Vision systems today are getting very good at tracking people," says Eric Grimson, a professor at the MIT Artificial Intelligence Laboratory. Several labs in the United States have built instrumented rooms, which Grimson says have "small, embedded cameras on the walls, ceilings, and desktops that can pan, tilt, do motion tracking, keep track of how many people are in the room, deal with them as they walk past each other, and maintain a pretty good knowledge of where the people are."

Likewise, says Grimson, there are now many face-recognition systems both in the laboratory and the marketplace. These systems cannot pick out a terrorist walking around an airport as seen from a security camera, but they can identify someone using a full-frontal image from a database of a few hundred people. Some can even identify a person turned at an angle. "Systems perform in the 90 percent range on face recognition," says Grimson.

HAL does more than recognize faces: the computer even has aesthetic sensibilities. When HAL finds Bowman sketching, the computer says: "That's a very nice rendering,

Dave. I think you've improved a great deal. Can you hold it a bit closer? That's Doctor Hunter, isn't it?"

While artistic appreciation escapes today's computers, another scientist at the MIT AI laboratory, Tomaso Poggio, has developed a program that can identify a specific person within a group photograph and another that can recognize objects and faces from line drawings. That program can even say how close the sketch is to a stored template.

"If you look at individual components – for example, locating human beings in a scene – I think that there are several good programs," says Takeo Kanade, director of The Robotics Institute at Carnegie Mellon University. But none of these systems can do it all. HAL, on the other hand, is a general-purpose intelligence that can understand whatever it sees.

For example, says Kanade, HAL realizes that Bowman has ventured outside *Discovery* without his space helmet. "If you just tell me that particular problem, and tell me what the helmet is, and the color, I can probably write the program," says Kanade. Detecting any kind of helmet, in any color, is much more difficult. "We can recognize a particular helmet," says Kanade, "but not 'helmet' in general."

That sort of general-purpose recognition is a far more complex task. It goes beyond image processing and crosses the boundary into commonsense understanding and reasoning about the scene itself – tasks that are beyond today's state of the art.

Bottom line: Today, we can build individual vision systems that perform each of the tasks HAL performs in the film *2001*. But we can't build a single system that does it all. And we can't build a system that can handle new and unexpected environments and problems. To achieve that level of sophistication, we need something extra.

The Holy Grails

The extra something that all of these technologies need to work is natural language understanding and common sense. Indeed, it is these technologies that for many people define the field of AI today. Consider the famous Turing Test, which postulates that a machine will be truly intelligent if you can communicate with it by teletype and be unable to tell if the machine is a human being or a computer. According to Alan Turing, language skills and common sense are the essence of intelligence.

There's just one problem: language understanding and common sense are two things we don't know how to do.

Of the two, by far the most work has focused on natural language understanding, or comprehension of language rather than merely the recognition of speech. One of the leaders in this field is Roger Schank, director of the Institute for the Learning Sciences at Northwestern University. In the late 1970s, Schank and his graduate students at Yale University built a computer program called CYRUS, which was programmed to learn everything it could about former US Secretary of State Cyrus Vance by reading the daily newswires. Each time the program read an article about Vance, it would digest the facts of the article and store the information in a conceptual database. You could then ask CYRUS a question in English – say, has your wife ever met the wife of the prime minister of Great Britain? The program was actually asked this question and answered, Yes – at a party hosted in Israel.

Since then, Schank has focused on a technique he calls "case-based reasoning." Schank believes that people have a repertoire of stories they want to tell you. When you ask them a question, it triggers a story. And people use these stories to reason and make decisions about what to do in their lives. In recent years, Schank's institute has built a number of corporate training systems, which are really large databanks filled with stories from dozens or even hundreds of people who work for the organization. Got a problem? Ask the computer your question; the machine finds the appropriate story and plays it back to you.

The problem with Schank's systems is that using them is like having a conversation with a videodisc player. You get the feeling that no matter what you say, the response was previously recorded – like a trashy daytime television show.

Of course, HAL can clearly do things that Schank's systems can't do: HAL is curious. HAL can learn. HAL can create his own plans. It is doubtful that one of the cases programmed into HAL was a recipe for eliminating the crew.

For nearly two decades, another AI researcher, Doug Lenat, has been working on a different approach to teaching computers to learn and understand. "Almost everything that we would characterize as HAL, almost everything that separates HAL from the typical PC running Windows 95, hinges around this word 'understanding,'" says Lenat. "It hinges around the totality of common knowledge and common sense and shared knowledge that we humans as a species possess."

As Lenat sees it, the differences between HAL and your PC isn't a magic program or technique, but a huge "knowledgebase" filled with rules of thumb, or heuristics, about the world. One entry might be: "When you are sleeping, you can't perform actions that require volitional control," says Lenat. Another might be: "Once you are dead, you stay dead."

Almost everything that separates HAL from a PC hinges around "understanding" – our common knowledge and common sense.

HAL would need facts like these to run the ship and care for the crew. And he'd need them to figure out how to dispose of the humans when they started to jeopardize *Discovery*'s mission.

Today there is only one database of common sense in the world. It's Cyc, the core technology used in the products of Lenat's company, Cycorp, based in Austin, Texas. Lenat and his fellow developers have been working on Cyc for more than 13 years. The knowledgebase now contains more than 2 million bits of assertions. All of the information is arranged in a complicated ontology.

Right now, says Lenat, Cyc is making progress in natural language understanding – it can understand commonsensical meanings in written text. Consider these two sentences: "Fred saw the planes flying over Zürich" and "Fred saw the mountains flying over Zürich." Though a conventional parser would say that these sentences are 188 ►

◂ 187 ambiguous, Cyc knows that it is the planes that are doing the flying in the first sentence and Fred who is doing the flying in the second.

Cyc can make these discriminations because the words "planes" and "mountains" are more than just plural nouns: they are complex concepts with many associations. Lenat believes that it's this sort of deep understanding that's necessary for the majority of jobs HAL does. And Lenat thinks that it is only a small step from a Cyc-like database to true machine intelligence.

"Cyc is already self-aware," says Lenat. "If you ask it what it is, it knows that it is a computer. If you ask who we are, it knows that we are users. It knows that it is running on a certain machine at a certain place in a certain time. It knows who is talking to it. It knows that a conversation or a run of an application is happening. It has the same kind of time sense that you and I do."

taught Lenat that there had to be more to learning than trial and error.

Lenat started the Cyc project in an attempt to get away from the boring world of abstract math. Immediately he had a problem: the system couldn't learn about the world in general because there was too much that it didn't know. This is where Lenat got the idea of "priming the pump" by giving Cyc a conceptual understanding of the world. Once that framework was large enough, Lenat reasoned, the computer would be able to start learning on its own – for example, by reading and conversation.

So how much priming does Lenat think is needed? In 1983, Lenat believed that it would take 10 years of work to get Cyc to the point that it could start to learn English on its own, unsupervised. Today, "I'd like to say we will get there by 2001," Lenat says. "We think that we are right at the knee of the curve." Lenat says that if he is right, then by 2001 the Cyc program will start being a "full-fledged creative member of a group

I thought real breakthroughs in AI were just 5 to 10 years away. Today, I doubt we'll see a sentient machine for another 30 years.

This is a lot more than simply programming a computer to say "I am a computer." Cyc knows what a computer is, and can use that knowledge to answer questions about itself. Like a person, Cyc can perform a chain of reasoning.

But Cyc can't learn by itself. All of the heuristics in the Cyc knowledgebase have been painstakingly entered by Lenat's developers, or "ontologizers," as he calls them.

Lenat's dream has always been to create a computer program that could learn on its own. His PhD thesis was a program called AM – Automatic Mathematician – which was designed to discover mathematical patterns. Over hundreds of runs, AM discovered addition, multiplication, and even prime numbers. But the program always stopped working after a few hours. Why? AM learned by making experimental modifications to itself and keeping mutations that were interesting. Invariably, something important in the program got modified out of existence. This that comes up with new discoveries. Surprising discoveries. Way out of boxes."

Bottom line: Understanding is the key to AI. More than anything else, it's the one technology that eludes science. With true understanding, all of the other AI systems would fall into place. And without it, none of them will ever achieve their potential. Give it 10 to 30 years.

Bottom bottom line

In the years after the making of *2001*, an interesting rumor began to circulate: HAL's name was a play on the computer maker IBM – the letters H, A, and L each coming one letter in the alphabet before the initials I, B, and M. Arthur C. Clarke vigorously denied the rumor. The name wasn't a play on IBM – it was an acronym, of sorts, standing for the words "heuristic algorithmic."

Back in the 1960s, heuristics and algorithms were seen as two competing ways of solving the AI puzzle. Heuristics were simple rules of thumb that a computer could apply for solving a problem. Algorithms were direct solutions. HAL presumably used both.

Was Clarke fudging? Perhaps more than a little. The real truth is that nobody had a clue how to build an intelligent computer in the 1960s. The same is largely true today.

Looking back, the early advances in artificial intelligence – for example, teaching computers to play tic-tac-toe and chess – were primarily successes in teaching computers what are essentially artificial skills. Humans are taught how to play chess. And if you can teach somebody how to do something intellectual, you can probably write a computer program to do it as well.

The problems that haunt AI today are the tasks we can't program computers to do – largely because we don't know how we do them ourselves. Our lack of understanding about the nature of human consciousness is the reason why there are so few AI researchers working on building it. What does it mean to think? Nobody knows.

"I think the hardware that is necessary for what HAL has is available," says Stanford's David Stork. "It's organization, software, structure, programming, and learning that we don't have right."

That's a lot of stuff. And it's a dramatic ideological reversal from the 1960s, when AI researchers were sure that solutions to the most vexing problems of the mind were just around the corner. Back then, researchers thought the only things they lacked were computers fast enough to run their algorithms and heuristics. Today, surrounded by much more powerful computers, we know that their approaches were fundamentally flawed.

When I started working on this article, I thought that real breakthroughs in AI were just 5 to 10 years away. Today I still think we'll see some breakthroughs in that time, but I doubt they'll culminate in a sentient machine for another 30 years.

Sooner or later, we will build a computer that can think and learn. Then we'll be able to stand back and let it reach for the stars. But whatever we do, we better not threaten to turn it off. ■ ■ ■

Talk with author Simson Garfinkel live Tuesday, January 14, at 2 p.m. PST at *www.wired.com/5.01/hal/*.

◂ 133 laborative attempts to turn his story into a script. "I can't tell you how many directions we went. My favorite was when David and Teddy got exiled to Tin City, a place where the old model robots, like old cars, were living out their days. Stanley definitely had the ambition to make another big science fiction movie, but in the end, we didn't get anywhere. Stanley called in Arthur Clarke and asked him to provide a scenario, but he didn't like that, either."

Kubrick, meanwhile, is as secretive as ever about his plans and insisted that powerful Warner Bros. co-CEO Terry Semel and Kubrick's then-agent, Michael Ovitz, fly to England to read the *AI* material under his personal supervision. The notion inspired awe and amusement in Hollywood, where the proud tradition of kicking "geniuses" around begins with D. W. Griffith and continues up through von Stroheim and Welles. Kubrick, who was born in the Bronx, has for the last 35 years lived a secluded existence in a palatial British estate in Hertfordshire.

Ovitz says there was a method to the madness. "It's true; he doesn't feel comfortable sending his scripts out, but we also wanted to have everyone in the same room, and you know Stanley doesn't fly. By the next day, Terry and I had a deal for Stanley to make the movie."

Of course, some information always leaks out – in this case, news that Kubrick has set *AI* in a future in which the polar ice caps have melted, drowning some well-known coastal cities such as New York. After having a special effects epiphany while watching *Jurassic Park* in the summer of 1993, he contacted the movie's digital effects supervisor, Dennis Muren of Industrial Light & Magic. Kubrick wanted animatics depicting computer-generated fly-throughs of a submerged Manhattan, its skyscrapers rising totemically from the tidal stew. Muren obliged (and flew to England to present the work).

Though it was reportedly well received, Kubrick was keeping his options open. In the summer of 1994, James Cameron flew to England when Kubrick asked the younger filmmaker to show him *True Lies*. "I was really honored, 'Oooh, Stanley Kubrick wants to see my movie!'" remembers Cameron. "But it turns out that he does this with everybody. He's like a brain vampire. He likes to get people and suck what they're doing out of their heads." The two viewed the film on an editing machine at Kubrick's home and talked about the effects shot by shot.

As for *AI*, Cameron reports that "Kubrick was interested in Digital Domain, passingly, to do some visual effects, and he showed me some of the artwork for *AI*. There was a lot of water interaction stuff – very difficult." But beyond that, Cameron is as tight-lipped as Kubrick. "It's his movie," says Cameron. "He can talk about it if he wants to."

But apparently he doesn't. Word began circulating that Kubrick planned to do all the *AI* effects himself, in his home workshop. The filmmaker has been known to operate his own handheld camera, and his hands-on enthusiasm is legendary. Kubrick will call up a given technology company – the manufacturer of a sound system, a film stock, or a piece of camera equipment – have the thing delivered, test it exhaustively, and notably not pay for it, explained one industry observer. Then Kubrick will send back extensive notes on what the machine can and can't do. Though this R&D ethic causes some grumbles in the industry, it works – companies develop new technology specifically for him.

In this case, Kubrick got the local boys from Quantel to set him up with a demo of the Domino, a computer graphics workstation known for its ease of use and real-time playback. Although the machine was said to have enthralled the filmmaker, his plan to do the special effects himself seems to have been scrapped; Kubrick put in another call to ILM this fall, this time requesting that Muren fly to England to read the script he had written himself.

Muren, well under way with Steven Spielberg on *The Lost World* (aka *Jurassic Park* part two), declined. "Stanley's been having conversations with Dennis for years," says an ILM staffer. "It's hard to feel like the train's about to leave the station."

Will the 68-year-old Kubrick ever realize this high tech opus? According to some of the more out-there speculation, he's already begun. One rumor – popular on the Net – holds that he's filmed two short segments of *AI* since the project began almost a decade ago to incorporate the natural aging of his young star, said to be *Jurassic Park*'s Joseph Mazzello. While a spokesperson for Mazzello confirmed that in 1993 there was a deal brokered between the actor and director, she said it was for another stalled Kubrick project, *The Aryan Papers*, and had nothing to do with *AI*.

A more plausible scenario, circulating not on the Net but in Hollywood, is that Warner Bros. – gun-shy after lackluster returns on Kubrick's *Full Metal Jacket* – balked at the big-budget bucks it would take to film *AI* and convinced Kubrick to first tackle the commercially bankable *Eyes Wide Shut*. Then they'd set him loose in the toy shop.

_AI_ is set in a future when scientists have found a way to link computer circuitry with synthetic flesh.

One hopes, when all is said and done, that Kubrick still has the desire to play. "I have a feeling, having worked with him, that he hasn't got the dashing confidence of youth," says Aldiss. "But of course, with age, you acquire a different sort of confidence." The director's creative vision, meanwhile, is clearer than ever. "Stanley embraces android technology," Aldiss notes, "and thinks it might eventually take over – and be an improvement over the human race." ■ ■ ■

Talk with Paula Parisi live Tuesday, January 21, at 1 p.m. PST at www.wired.com/5.01/ai.

SETI

◂ 141 the other members were likely to be older than ourselves. The Milky Way galaxy is at least 12 billion years old, while Earth has been around for barely more than a third of that time. Morrison has called SETI "the archeology of the future."

The technical challenges to extraterrestrial search are as daunting as the metaphysical ones. There are more than 400 billion stars in the galaxy, and just in the so-called "water hole" part of the microwave spectrum, where low background radio noise favors long-range transmission, there are some 2 billion frequencies on which to signal. Successful searching then requires vigorous channel surfing as well as star hopping. In the 1970s, a study group composed of academics and NASA researchers proposed that the best way to accomplish this was by constructing an array of radio dishes, dubbed "Project Cyclops," at a price as high as half a billion dollars. Proxmire came down with a severe case of sticker shock, and in 1982 NASA was forbidden to spend a dime to study the idea of SETI.

But shortly thereafter, the two sides reached a truce of sorts. Proxmire allowed NASA to proceed with a modest research program based on the development of multichannel receivers that could scan and analyze the signals from millions of frequencies simultaneously, thus obviating the need for a Cyclops-sized array with its gigantic price tag. The new search had two parts: an all-sky survey to detect signals from anywhere in space, using existing NASA antennas, managed by the Jet Propulsion Laboratory in Pasadena, California; and a targeted study of roughly 1,000 nearby Sunlike stars, managed by NASA Ames Research Center in Mountain View, California. The latter part of the project was to be carried out largely by the SETI Institute, a low-overhead nonprofit organization also in Mountain View. Drake, who had moved to the University of California at Santa Cruz, was and is the institute's president. With great fanfare, the unpoetically named High Resolution Microwave Survey went into operation on Columbus Day, 1992. But less than a year later, after only a few shakedown cruises, it was Proxmired into oblivion by a new hero of the taxpayers, Nevada Democratic Senator Richard Bryan.

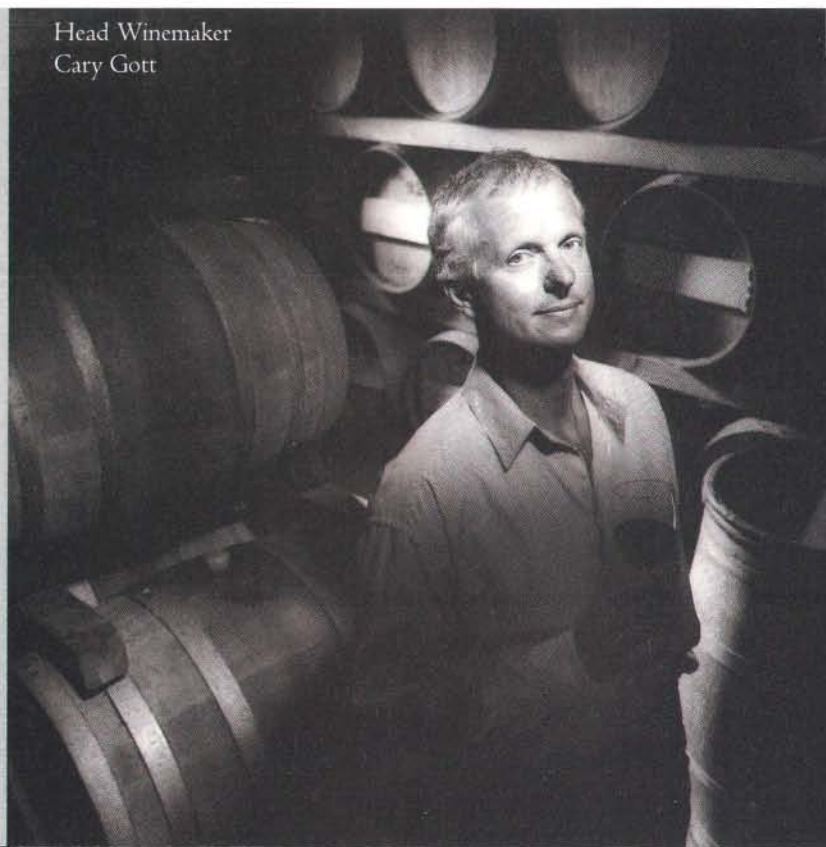
SETI is less a science than a philosophy, a recognition that those unplumbed light-years are full of possibility.

Nevada, it is noted with bitter irony by the scientists at the SETI Institute, is home to the "Extraterrestrial Highway," a stretch of road near the infamous Area 51, a reputed UFO hotspot. In Mountain View, they did not take this new insult lying down. When Congress pulled the plug, Drake and the others took a crash course in fund-raising. With NASA's bless-

BANKERS DREAM OF BEING MOVIE MOGULS.

MOVIE MOGULS DREAM OF BEING WINEMAKERS.

SO WHAT DO WINEMAKERS DREAM OF?



Head Winemaker Cary Gott

Cary Gott would be the first to admit that his idea of a dream job is the one he already has. And since he truly loves

ing and an indefinite loan of the new multichannel receivers, the star survey went private. Among other donors – including, appropriately, Arthur C. Clarke – the renamed Project Phoenix found four angels among the titans of West Coast high tech: David Packard and William Hewlett of Hewlett-Packard fame; Gordon Moore, the founder of Intel; and Paul Allen, cofounder of Microsoft. Each kicked in a million dollars; the four have all made subsequent pledges to contribute several million more to maintain the star search at a minimal level for the next five years. The institute's finances received another, not entirely happy, boost in late 1995 when SETI pioneer Barney Oliver, HP vice president of R&D and principal author of the famous *Project Cyclops* report, died and left the institute an estimated US$10 million to $20 million. Hundreds of others have donated smaller amounts.

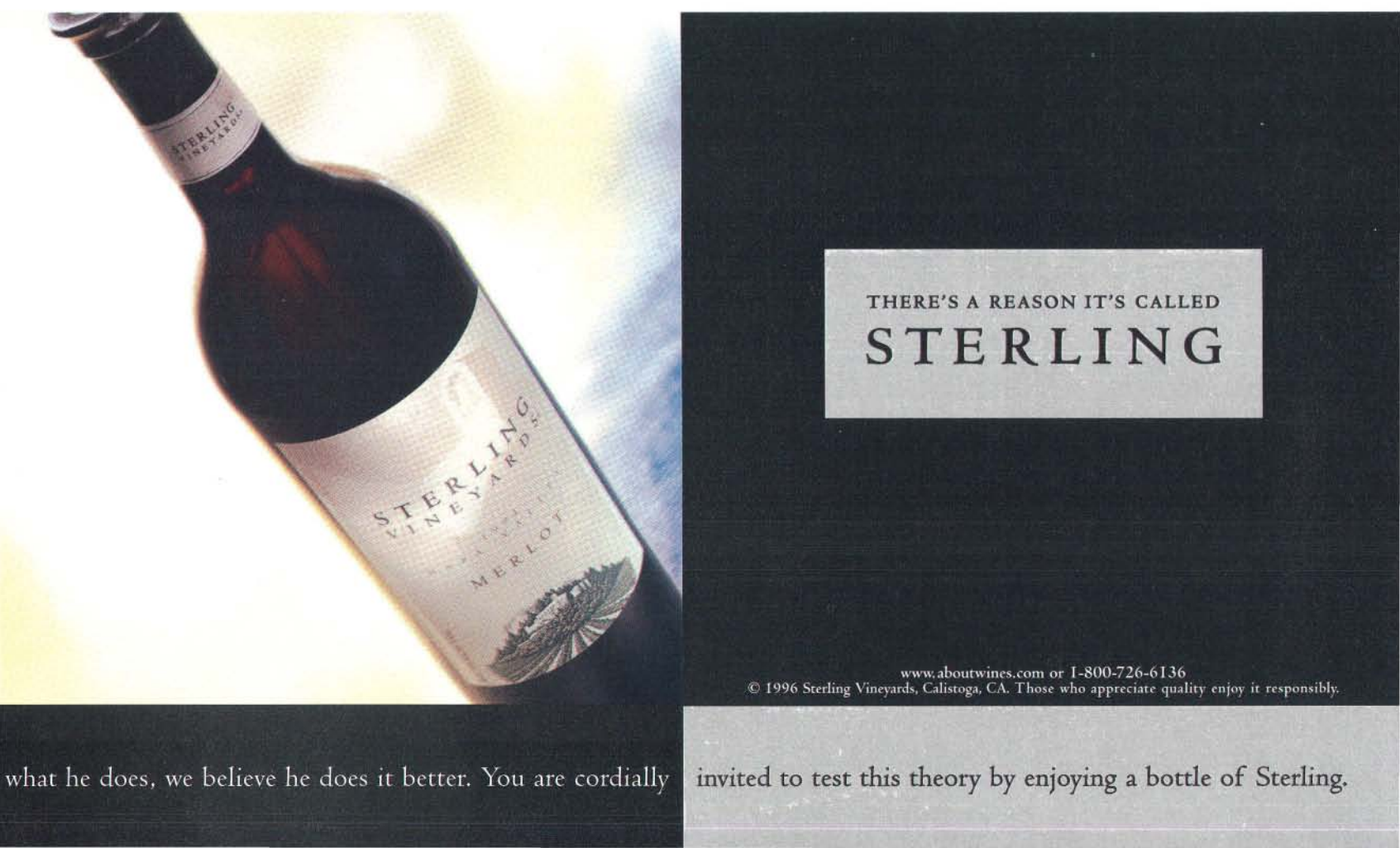
In 1995, the institute's scientists spent 16 weeks at the Parkes radio telescope in Australia surveying about 200 solar systems, looking for signs of intelligence. They easily detected the 5-watt transmitter of *Pioneer 10* approaching the edge of the solar system, but no unidentified signals yet. In October 1996, Project Phoenix scientists set up shop indefinitely at a 140-foot-diameter radio telescope in Green Bank. Given that it takes half a day to scan all 2 billion channels for any given star, they may finish the initial list of 1,000 stars before their money runs out – leaving only about 99.9999999 percent of the galaxy to go.

SETI-on-a-shoestring survives in other forms, most notably in the efforts of Paul Horowitz, a Harvard physicist who, with funding by The Planetary Society, has been scanning the skies with a small radio telescope outside Boston for the last 10 years. In October of 1995, he relaunched his survey under the name Project BETA with a new, quarter-billion-channel receiver of his own design. Speaking at the rededication, Drake reiterated his prediction that contact would be made by the end of this century.

When I called him last fall, Drake conceded a little nervousness about that optimism. "I might have to change my name," he chuckled, adding that he had learned about the Mars rock when *ABC News Nightline* called him for a comment. Drake admitted to being gratified, although not surprised, to see so many of the ideas he has advocated over the years coming true. After all, the possibility of fossils on Mars has been discussed for years. "Life is easy," he said. "There are a multiplicity of possible origins. The big question is not whether it started, but *which way* did it start."

SETI is a crazy idea. The only issue, to paraphrase Niels Bohr, the renowned quantum physicist, is whether it is crazy *enough*. For most of us most of the time, the stars might as well be white dots stuck on a dark globe over our heads. But there is a real universe Out There. SETI is less a science than a philosophy, a recognition that those unplumbed light-years are full of possibility. We might tap into the cosmic internet, or we might fall into a mind-aching silence.

The discovery of an alien signal would not end history, bring peace and 192 ►



SETI

◂ 191 justice on Earth, or necessarily solve any outstanding scientific issues. In the absence of physical contact, it might be, after the initial enthusiasm, a rather dry and academic affair, like finding and interpreting strange hieroglyphs in the desert. Disputes about its meaning could drag on for centuries, as could debates on whether or not to send a message back. A protocol signed by a variety of international organizations stipulates that any response would be preceded by international consultations, yet once the coordinates and frequency are known, anybody with an antenna will be able to send a message. Drake beamed his own short signal toward the globular cluster M13 back in 1974. Earth as a whole has already been broadcasting to the universe for half a century: a chattering bubble of radar, *Howdy Doody*, Top 40 radio, and Edward R. Murrow that is now a sphere about 100 light-years across.

dares not speak.

Perhaps it is no wonder we are awash in alien chic these days. Any shrink will tell you it's not healthy not to be able to say what you want. Truth repressed squishes out the sides, like toothpaste, into fiction, dreams, art, and hysteria. Forbidden thoughts have a tendency to become attached to convenient strangers, which is how men of God can decide that women are fornicating with the Devil or that Irishmen eat babies. When the Soviet Union melted like a wax witch, it left an enormous vacuum in the ranks of faceless evil which our imaginations have perhaps begun to fill with aliens. But that's not the whole story. Numbness is numbness. As the psychiatrist Robert Lifton has shown in his classic studies of Holocaust and other disaster survivors, when terror is repressed, so is joy. The flip side of *Independence Day* is *Close Encounters of the Third Kind*, in which aliens symbolize transcendence, mystery, and the beauty of the universe – concepts increasingly

Washington's reluctance to look Out There has resulted in a kind of psychic hole in our exploration of the universe.

As a practical matter, the scientists at the SETI Institute are happy not to have to troop to Washington, DC, once a year to defend their program from trophy-hunting congressmen. But philosophically, they resent being left out of NASA's Origins program. The discovery of intelligent life would be the grand prize and the logical culmination of a project that sought to discover the origin of things in the universe. "SETI is a program that NASA should be doing," says Seth Shostak, an astronomer at the institute. What is the point of looking for planets like ours, he wonders, if not to ask if there are folks like us living on them? That, however, is exactly what the congressional decree killing NASA's survey forbids. Senator Bryan failed to respond to a request for an interview. His opposition to a NASA-based search has continued. The result is a kind of psychic hole in our exploration of the universe. Thanks to Congress, SETI is the truth that NASA difficult to articulate in a utilitarian age in which politicians are more in thrall of the bond markets than of any notions of justice or freedom. Science marches on and often over our myths and comforts; there is no room on Earth for elves, angels, or goblins anymore. In postmodern society the notion of transcendence is as forbidden and unfashionable as cannibalism. Yet folk cultures of the world abound with stories of the forsaken brother who returns to haunt us as a wolf or a bigfoot, and of the humble orphan who discovers he is really a lost prince. In our secret inconvenient hearts we remain hipsters burning for that old heavenly connection. The truth that NASA dares not speak is that we yearn for contact, even as we dread it.

The truth is out there. ■ ■ ■

Talk with Frank Drake and author Dennis Overbye live Tuesday, January 7, at 1 p.m. PST at *www.wired.com/5.01/seti/*.

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"I am a HAL Nine Thousand Computer Production Number 3. I became operational at the HAL Plant in Urbana, Illinois, on January 12, 1997."

It couldn't have happened anywhere else.

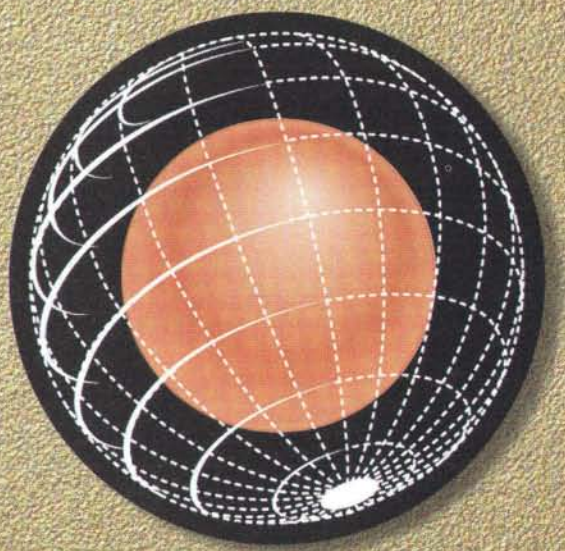
1952
ILLIAC, the first computer built and owned by an educational institution, becomes operational. It was used by UI faculty to compose and play the *Illiac Suite*, the first computer-composed musical work.

1961
Using the ILLIAC, UI faculty introduce PLATO, the world's first time-shared computer-based educational system.

1986
NCSA Telnet, software written by computer science students Gaige Paulsen and Tim Krauskopf, allows users to access remote sites from their desktops.

1993
UI develops Mosaic and sparks the World Wide Web revolution. Most of the development was done by computer science students and alumni, including Marc Andreesen and Eric Bina.

University of Illinois at Urbana-Champaign



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Israeli Phone

◂ 149 By the early 1990s, after several fits and starts, the poor performance, unresponsive customer service, unstable finances, irregular personnel behavior, and complicated decision-making processes that characterized the old, government-run service had all but disappeared. Indeed, Bezeq now insists that it ranks among the 10 most efficient phone companies in the world.

Suddenly, Israelis found themselves laden with premium telephone services either not available in most countries or available only for additional costs. Israelis get call-waiting for free, Caller ID and voicemail for a pittance, and various other premium services not widely used by American consumers.

Then Cellcom received its license in June 1994. That summer was devoted to recruiting a small team of local engineers and communications technicians, recalls Shalom Manova, Cellcom vice president for engineering and network operations and a former high-ranking Israel Defense Forces Communications Corps officer who cut his teeth on electronic warfare. He says most of those recruits were fellow communications branch veterans "with lightning in their eyes."

Work on the new network began in September, and by the time Cellcom opened its subscription campaign in late December, the company had one working switch and 38 cell sites providing coverage over the Coastal Plain, which flanks Tel Aviv. The company quickly hit its stride, moving a new cell site into operation every 1.5 work days. Cellcom eventually extended its coverage throughout the country, from Kiryat Shemona, at the northernmost tip of Israel, to Eilat, the nation's southernmost point.

By March 1995, Cellcom had wrested a third of the wireless market from PelePhone, established in 1986. Sound quality still wasn't great, mind you – there was even talk within Cellcom of having to "educate" Israeli ears to the exigencies of digital telephony; notably, a tinny, almost inhuman sound that suffers in comparison with analog. It sometimes seemed like the country's TV comedians were getting more use out of the new telephones – by bashing them – than the people who owned them. Yet cancellation rates remained low. Given the ludicrously low rates they were paying, Israelis seemed willing to give Cellcom a chance to get its act together.

Their patience was tested more severely, however, during what is now referred to as The Great Foul-Up. In April, when Cellcom hit overcapacity in both switches and cell sites, customers began complaining about access problems. Users would dial a number, press Send, and receive "system busy" messages. Calls would take hours to get through. By the end of the month, system hangs – software errors that froze telephones in mid-dial – had become pandemic, and subscribers started getting pissed off.

Cellcom's handling of The Great Foul-Up was an amazing lesson in the art of turning a technical disaster into a marketing coup.

Cellcom's initial response was to blame consumers for talking too much, or for using their phones indoors and outdoors with equal aplomb. Still, the company acknowledged that it had a problem, and that the problem was most likely of its own making. Manova called for help from his equipment provider, Northern Telecom. The Canadian company flew in a team of experts, and during the next month, as problems grew progressively worse, the experts and Manova's engineers hacked the switches, the software, and every other component of the system – to no avail.

"On a certain Friday," recalls Manova, "15 of us sat at the switch, and before breaking for the Sabbath, we asked ourselves what else we hadn't considered. I wondered if maybe we shouldn't be looking at an external factor – something in the air – instead of something going on from within the network." Manova dispatched troubleshooters, equipped with network analyzers, to his highest antenna sites to check the signals to and from the cell phones. Three hours later, one of his crew members called in to report peculiarities in some signals. Manova checked those signals and realized he was dealing with a carrier jam – a signal imposed on Cellcom's system that had no business being there.

Trained to wage electronic warfare, Manova first suspected that his network had come under attack. Further experimentation, though, revealed that the attack was not coming from a hostile neighboring country or even from a competitor, but from the phones of ordinary Cellcom customers. To determine why this was happening, he dispatched four teams into the streets of Tel Aviv. Their job was to chase down subscribers, politely confiscate their phones, and determine the source of the problem.

The engineers quickly traced the problem to a bug in the system software used in the Motorola handsets. Further research revealed that a similar crash among identical Motorola phones had hit a provider in Hong Kong. Manova complained to Motorola, which, he says, at first denied culpability. "But we didn't let them weasel out of it," he says. Technical discussions quickly led to the disclosure of a known bug – and a known fix.

Cellcom immediately put its marketing efforts on hold and announced a flash recall operation. Tens of thousands of users were enticed to visit a series of recall stations where they were treated to free food, gifts, and entertainment while their phones were debugged – a process that generally took 15 minutes per phone and cost the company millions.

Many customers told reporters that rather than feel inconvenienced, they'd found the entire spectacle invigorating. "It was amazing," recalls commentator Yaron London, one of Israel's most prominent social critics, "a virtual lesson in the American art of turning a technical disaster into a marketing coup. It's unfortunate, but we don't like to apologize in this country. Israelis were so shocked at finding a company willing to admit

blame, assume responsibility, and make amends, that Cellcom not only held on to its customer base but assured itself of continued growth."

Located in Herzliya, an upscale beach community directly north of Tel Aviv with a burgeoning reputation as Israel's Silicon Valley, Cellcom is currently locked in bitter negotiations with Motorola Israel, located in Tel Aviv, over the damages due Cellcom as a result of Motorola's witting delivery of thousands of defective cellular telephones. The dispute, some observers believe, will likely have to be settled in the courts.

Motorola's failure to apprise Cellcom of known defects in its telephones may have more than a little to do with Motorola's financial interest in Cellcom's competitor, Pele-Phone. Pele-Phone emerged from Cellcom's Great Foul-Up with its reputation for reliability greatly enhanced. Certainly Pele-Phone used Cellcom's crash as an ample demonstration of the attractions of being analog.

Cellcom has already complained about the conflict of interest inherent in the fact that Bezeq, in its capacity as Israel's sole telephone provider, supplies Cellcom with long distance and other telephone services while also maintaining a proprietary interest in Pele-Phone.

This situation may be resolved now that the Israel Communications Ministry opened up the long distance market in November to other telephone service providers to compete with Bezeq. Israelis also are bracing themselves for the imminent arrival of a third cellular provider, an event that could spark even greater telecom competition and innovation.

Regulators initially anticipated licensing a third provider either by 1999 or when the cellular market reached an unimaginable 200,000 subscribers. Now that the country is closing in on 1 million cell phone users, the new provider will probably be licensed soon.

The Israeli government is considering moving the military out of parts of the 900-MHz range it occupies (which the Palestinian Authority covets as well) and awarding the new provider a good chunk of the vacated spectrum real estate. This is a range that has been earmarked in the US for personal communications services, which are the low-powered, low-cost mobile-phone and data transmission systems that are expected someday to bring Cellcom-like prices (now hovering at about 10 cents a minute) to the American masses.

Ironically, Cellcom, which has to share the 800-MHz range with Pele-Phone, is not thrilled by the prospect of opening up the 900-MHz range quite yet. The company invested hundreds of millions of dollars in setup costs and has not yet made that money back. Cellcom does not see how it can do so without eventually being allowed to expand into the 900-MHz range – especially since it and Pele-Phone appear to be reaching capacity. "It's not logical, from the perspective of a country that wants to encourage investment," says Cellcom's Oren Most, "that before a company like Cellcom can set up and establish its business, you open up a competing store across the street."

The soldier ordered a pizza with his cell phone, but when the van arrived at the sandbagged outpost, his commander threw a fit.

Perhaps more ironically, Bezeq CEO Yitzhak Kaul, who has a stake in Pele-Phone and who may have the greatest stake in maintaining what's left of Bezeq's erstwhile monopoly, says he looks forward to the added competition. *"Ahalan wa'sahalan,"* he says, invoking a traditional Arabic greeting. "Competition is the best thing that ever happened to the telecommunications industry in this country. Even when it's against me."

Mangos and the military

The vaunted Israeli army, alas, was not as sanguine about the possible benefits of cellular phones – at least not at the outset. In 1995, for instance, a soldier manning an outpost near the Lebanese border finished off a stint of guard duty by ordering a snack – a pizza from a nearby pizza parlor. He used his cell phone to call for the delivery. When his commander saw a pizza van pull up to the sandbagged entrance to the guard post, he threw a fit. That fit made front-page news.

News also spread over the Net – with the usual apocryphal embellishments. The soldier, some denizens of the Internet declared, was really an entire armored personnel-carrier patrol in southern Lebanon. And Iranian-backed Hezbollah guerrillas, armed with RadioShack scanners searching the 800- to 900-MHz bands, ambushed the soldier and his mates who were on their way to the rendezvous with the pizza van. There were no survivors. Talk about chutzpah: legend has it that the guerrillas used the soldier's cell phone to call in news of their hit to an Israeli media outlet.

"Nonsense," says Lieutenant Colonel Sharon Grinker, a spokesperson for the Israel Defense Forces, in reference to the Net version of the pizza story. "It never happened," he insists. But the original article, and its prominent placement, pointed to a growing discomfort within the IDF over the possibility that cellular use within its ranks had gotten out of hand.

For guys like me, who served a generation ago, one explanation for the cell phone craze may lie in a lingering recollection that in the old days – the '80s – only officers possessed military radio sets, and only full colonels and higher were issued mobile telephones for their cars.

In the Israeli army, it is not unusual for noncommissioned officers to call colonels and even generals by their first names. Cell phones appear to have propelled this kind of familiarity to new heights by reestablishing the kind of direct egalitarian communications that existed in the early years of the state. Soldiers can now call up their commanding officers directly, bypassing their secretaries and aides. Indeed, since Israeli grunts all see themselves as full-fledged generals, most, whether in active service or reserves, now quite properly regard pelephones as standard issue. 196►

Israeli Phone

◂ 195 Israel's Officer Training School even unofficially encourages an instructor to use his cell phone to reach units conducting live-fire exercises in the field if the instructor's jeep radio fails to reach them. Such use has become *pakal* – IDF standard operating procedure. An instructor would no more show up for duty without a full charge in his cellular batteries than with unloaded magazines for his Galil assault rifle.

And when the officer or an older reservist gets a break in the action, he can conduct a little business on the side. "During the Intifada," recalls London, "my son told me that he and his patrol of fellow reservists would chase these Palestinian kids in Gaza who had pelted them with rocks. After things were under control, the guy in their unit who owned an aluminum factory would pull out his cell phone and direct his business while stooped in a doorway."

Young Israeli conscripts are no less wired. Although they tend to leave their walkmans and Game Boys at home as they march off to three years of compulsory service, none forget their Mangos.

Devised by Pele-Phone to combat Cellcom's low rates, these devices are bottom-end cellular telephones rigged to receive all incoming calls free of charge to the holder, but to deliver outgoing calls to only one predetermined number. Designed initially for businesses, the $200 Mango (think *man go,* as in *walk man,* and only later, mango, the fruit) quickly became the favorite of parents who wanted to know the location of their kids but didn't want to subsidize their verbal frippery. It was a great idea because the Mango was configured to call only one commercial number – usually a parent, girlfriend, or boyfriend. It also could call emergency numbers, such as the police or an ambulance.

However, if you used a Bezeq phone card, you could reach other outside numbers – provided you were prepared to pay the price. The cost of using the Bezeq card option with a Mango turned out to be prohibitively expensive – several times Pele-Phone or Cellcom rates. Bezeq obviously realized that putting such options in the hands of kids was like tempting them with the keys to the candy store. Many could not resist using the Mangos and cards in tandem, racking up charges that caused some parents to blanch when the monthly bills came in.

From the army's perspective, the problem with Mangos, or any cell phone, was never that enemy scanners might pick up sensitive information, says Grinker. Israeli soldiers have long been inculcated with a concern for field security. And Israeli cellular standards are notoriously difficult to scan.

But the endless phone calls by soldiers trying to organize the evening's social gatherings did start to get in the way of normal staff work. In February 1996, for instance, tank school commanders complained that more than 90 percent of the new recruits showing up for basic training came equipped with cell phones. Any time a commanding officer deprived his charges of the six hours of sleep guaranteed by general orders, they could call home to complain, and the parents, who had served in the same citizens army and retained a proprietary feel for the institution, could call the base commander to ream him out.

The army realized it couldn't fight technology in the face of such a social obsession. So why not exploit it?

The IDF's answer was not to ban cellular telephones, but to restrict private cell phone use to break time and off-hour periods. However, officers with the rank of major and above are permitted to use their discretion in allowing or disallowing phone use. Some, like Grinker, maximize their utility: "It's very convenient for me to be able to call my soldiers if they are taking a walk in the city and have them report to me in 15 minutes if I need them. Without the phones, I'd have to restrict them to base or my office.

"We had to understand that this technology doesn't have to get in the way of running a modern army," Grinker says. "Today, everything is possible. We have the technology – why not exploit it?" Now, with cell phones, parents are more connected to their children than ever before. The children, in turn, may be more motivated to serve and less inclined to view service as onerous.

"We are, after all, a people's army, and whatever finds its way into Israeli society finds its way into the army," says Grinker. "The army understood that it couldn't fight technology in the face of such a social obsession. It also understood that there were major societal benefits to allowing soldiers to use their phones."

But then, cell phones are not all they appear to be.

In January 1996, Israel's internal security service, or Shabak, allegedly used an exploding cell phone to assassinate Palestinian suicide bomb mastermind Yahya Ayyash, aka The Engineer. It's interesting to note that the head of the Shabak when that operation was being planned was Ya'akov Peri, the same fellow who later would become Cellcom's CEO and try to sell *everyone* in Israel a Cellcom cellular phone.

The Palestinians are always quick to pick up on an effective Israeli tactic. In October, when Israel lifted its quarantine on the West Bank and Gaza, Israeli police caught a Palestinian trying to cross the border with a similarly rigged cell phone. The phone, they believe, was intended for use against an Israeli politician.

Present-day Israel may indeed be wired to the max, but the Jewish state remains as divided as ever. Secular Israelis are not using their new connectivity to schmooze religious fundamentalists, the fundamentalists are interested only in talking to God, and the extreme Right calls up the Left only to issue death threats.

Cell phone use may be exploding in more ways than one. But unless the people of Israel really start communicating, all these new connections may be for naught. ■ ■ ■

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Genome

◂ 161 to blue whales. DNA is always built from the same four chemical bases: adenine, thymine, cytosine, and guanine, arrayed in pairs to form a double helix. The precise sequence of base pairs varies not only from one species to the next, but from one individual to the next, affecting everything from hair color to longevity.

There can also be mutations. Some of these create beneficial, evolutionary improvements. More often, though, they interfere with normal functions.

More than 15 million Americans have one or more birth defects, 80 percent of them genetically caused. More than 3,000 diseases – hay fever, hypertension, hepatitis, dermatitis, Down's syndrome, lupus, pancreatitis, meningitis, muscular dystrophy, testicular cancer – will be present or absent depending on the vagaries of a person's genetic code. Two-thirds of serious hearing problems are genetically caused. Serious problems in the eyes and teeth are often genetic. The list goes on.

At first there was no obvious way to fix defects in DNA, since the molecule is far too small to be manipulated with ordinary tools. But some enzymes have the useful ability to cut DNA into pieces at well-defined points, allowing sections to be repaired or modified. This is how gene splicing became a reality.

In the summer of 1980, UCLA Medical Center announced the first animal gene transplant. Ten years later, doctors at the National Institutes of Health (NIH) completed the first gene therapy on a human being, using DNA that had been extracted, modified, and replaced. Other experiments followed quickly, and by September 1996, the Food and Drug Administration had approved 160 protocols for treating mostly serious conditions such as lung cancer and leukemia.

More action occurred outside human medicine, where the stakes – and controls – are not so high. In agriculture, the antifreeze gene from an arctic fish was transferred to soybean plants to protect them from low temperatures. Tomatoes that stay firmer longer were patented by Calgene; they are still being evaluated by the FDA.

All of these developments have been made possible by mapping DNA. At first, this was a slow, erratic business. In 1985, a centrally coordinated plan to discover the sequence of the entire human genome was discussed in a conference at the University of California at Santa Cruz. One year later, the Department of Energy expressed interest, following its studies of genetic damage caused by nuclear radiation. A year after that NIH got involved, and the two agencies jointly announced the Human Genome Project, a huge cooperative enterprise that would begin in 1990 and reach its goal in 2005, drawing on contributions from laboratories all over the world.

Many scientists complained that DNA sequencing would be hideously expensive, diverting money from other research that seemed more important. The sequencers won out, though, and the result has been a torrent of data.

By mid-1996, GenBank listed 700 million base pairs from 18,000 species. Storing this information is easy. The hard part is interpreting it.

The database Michael Gribskov maintains at the San Diego Supercomputer Center is a small venture dedicated to just one family of molecules. A truly vast electronic library is needed to store all data from the Human Genome Project, along with other DNA sequences from thousands of species of animals and plants.

There are now three of these giant repositories: one in Tokyo; one in Cambridge, England; and a third, GenBank, in Bethesda, Maryland, maintained by the National Center for Biotechnology Information (NCBI), sponsored by NIH. The three databases constantly share and trade data so their archives are all complete. But GenBank, the oldest, has done the most to leverage the value of genetic data by the intelligent application of powerful computers. By mid-1996, it listed 700 million base pairs from 18,000 different species. Storing this information is relatively easy. The hard part is interpreting it.

GenBank

The NIH campus is lushly landscaped. Modern buildings nestle amid low, rolling hills of neatly trimmed grass, and tall trees rustle in the wind. Washington, DC, lies just to the south, but this feels like open country.

In early-morning sunlight I walk past Bethesda Naval Hospital, where American presidents receive their medical care. Farther along a gently curving road is the National Library of Medicine; but my destination is a smaller, glass-walled building on a side road. Here, in a series of tiny cubicles, the NCBI scientists maintain GenBank.

Mark Boguski is a senior investigator, looking hearty and energetic, highly motivated as he rests his lanky frame on a utilitarian chair in the cafeteria at 8:30 a.m. He doesn't fit the stereotype of a cautious, conservative government scientist; he's very informal, very direct.

"A DNA sequence, in isolation, is meaningless," he says. "You need to know where it came from and what it does. The National Library of Medicine has been collecting data since before the Civil War; it started as a handful of books that the Army Surgeon General owned. Today it indexes about 400,000 articles a year, and this literature is what gives sequences their meaning: the database doesn't just store sequences, it links them with all the citations. And that enables users to make new discoveries."

Around us, government employees are eating breakfast. Boguski doesn't seem to notice; he's too enthused by his topic. "Here's an example," he continues. "Someone cloned a gene for Alzheimer's disease and looked for similar sequences here. They found one in a nematode worm. So now they can do experiments on nematodes that have applications back to the human brain! Another example: a scientist wants to know more about a gene in mice. A search for the sequence finds similar proteins in yeast. So now she can do cheap experiments on vats of yeast instead of expensive experiments with mice, and ultimately the work will map back to another similar gene in humans."

This sounds simple – but it isn't. The key word here is *similar*. A gene may serve the same function in various species, but it won't have precisely the same structure.

Evolution is a mess of trial and error. DNA sequences diverge gradually over millions of years, guaranteeing differences.

So how do you know if two genes really are comparable? GenBank uses cunning algorithms to assess similarity, but the ultimate test has to be done in a laboratory. Suppose you believe that a human gene and a yeast gene serve the same function. To prove it, you remove the gene from the yeast's DNA and insert the human gene instead. Then you wait and see if the yeast still grows normally. "This has been successfully done with various genes about 75 times so far," says Boguski.

Biologists are accustomed to this kind of cumbersome, wait-and-see routine, but computer programmers find it maddeningly imprecise. "Their natural tendency is to want things simple," says Boguski. "But nature is incredibly complex. There's a big demand now for computational biologists, and computer people are moving into the field, but we really need people who are biologists first, computer scientists second."

Boguski himself was originally an MD, and he admits that he sometimes misses interacting with patients and being directly involved in their care. "Still, at some point you have to decide where your work is going to have the most impact. What I'm doing now has much more of a positive influence than I could ever have with individual patients. DNA sequences are the future of medicine – and this, here, is the medical library of the 21st century."

"Biology today is like physics before Newton. We are only just now starting to see meaningful patterns in the data."

Linking links

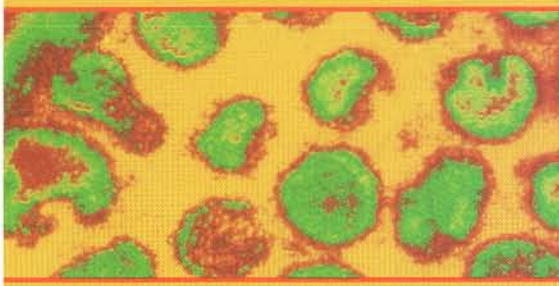
The principal architect of that library is Jim Ostell, who directed the basic design of GenBank's database in 1990. Ostell is lanky, long-haired, and bearded, with a nerdy but affable manner. He majored in zoology as an undergrad, then turned away from academia and took a job in 1972 gathering live organisms for a biological supply house. "I roamed meadows and ponds collecting amphibians, plants, and invertebrates in western Massachusetts," he recalls. He later went back to school for a master's and wondered how vastly complex organisms could grow from such simple beginnings. In 1979, he began working in the Harvard Bio Labs, where early attempts at DNA sequencing were under way.

The lab's only computer was a CP/M machine, comparable to a RadioShack TRS-80, which was used by a secretary to do word-processing during the day. The available programs for manipulating chemistry data were frustratingly primitive. Ostell wrote one of his own, started giving it away, and after he finished his PhD, he left the lab to market his software. For a while he lived in a Vermont farmhouse, leading a serene life composing computer code.

Eventually, though, he feared he was losing touch with developments in molecular biology. When NCBI offered him a job in 1988, he accepted. Fortuitously, when he found himself receiving offers from pharmaceutical corporations that would double or triple his government salary, NIH offered him a special title and position, Senior Biomedical Research Scientist, which Ostell shared with just 11 other people. It exempted him from federal pay scales, although he says he'd still do better in the private sector.

He prefers GenBank, though, because it allows him to deal with the full breadth of his subject. In his office, Ostell draws three circles on a whiteboard to indicate three areas of data. One consists of DNA sequences, another the protein sequences that genes create. The third contains genetic and other related literature from NIH's Medline database, the world's most comprehensive online medical research tool. GenBank has it all. No matter where you start, everything is linked. Even old literature is linked forward to new literature, and naturally the system displays the most promising hits first.

"We computed the comparison of all known proteins to all other known proteins," Ostell says. "We did the same thing with comparisons of English text; in each paper we assigned weighting to words 200 ►



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◂ 199 depending how often they repeated. We've now done this for the 1.2 million published citations in the genetic subset of Medline, and we're working on the remaining 8 million outside genetics." Thus, a newly identified DNA sequence can quickly be compared with others that may be better understood. Links can also be identified to medical conditions that result when a particular sequence is missing or damaged. Finally, there may be therapies that can be adapted and applied.

Initially, there was some backlash from researchers against a central government agency devising its own software, file structure, and user interface that everyone else would have to put up with. At one time NCBI was even accused of being "Stalinistic."

Fortunately, the man chosen to head it is a maverick biologist named David Lipman whose former ambitions included real-world occupations such as fiction writing and filmmaking. Lipman made it clear he didn't give a damn about dress codes or organizational protocol. He assembled a young, multinational workforce, and he infected them with a cheerfully arrogant, can-do attitude. As a result, GenBank behaves unlike any normal government agency.

Lipman was determined that the data should be accessible by anyone, anywhere, so Ostell's team developed user-friendly software for accessing GenBank, in versions for Unix, DOS, Macintosh, and even VMS systems. The flexible approach paid off: GenBank now processes 40,000 inquiries per day, not including casual visitors to its Web site. It measures its success by the number of people who use it – more like a market-driven business than a bureaucracy.

GenBank's system is based on Sun SPARCcenter 2000s, while four hulking Power Challenger XLs handle the similarity comparisons in sequence searches. Three full-time staffers run a help desk responding to users by email, phone, or fax. By modem, GenBank receives newly deciphered DNA sequences from hundreds of sources all over the world. Often, different laboratories will be studying the same gene; except that it won't be *precisely* the same, because of the slight genetic variation between the individuals sampled. As a result, GenBank holds multiple versions of many sequences, no two of them exactly alike. When the Human Genome Project completes its task, the final sequence will be selected from thousands of fragments, causing it to be a composite, like a morphed photo mixing multiple ethnic features.

So far, less than 5 percent of the total human genome has been sequenced. "Biology today is still like physics before Newton," says Ostell. "We are only just starting to see meaningful patterns in the data."

But once we understand DNA, he says, "it will make the electronics revolution look like a flash in the pan." He smiles thoughtfully. "I would guess that a lot of species die around this stage, because they acquire sufficient power to kill themselves."

There's no guarantee that everyday citizens will make wise use of genetic knowledge when it affects their personal lives.

One could argue that the nuclear physicists got us there first. And yet, Ostell's helping to accelerate the process.

He shrugs. "Nature produces more terrifying creatures than we can imagine. Humans are now the most widely available prey species on the planet, and the most likely predator is a virus. We need to understand the predators in order to defend ourselves."

But is it wise to make the information so publicly available?

"I think it's important that a clever grad student in Smallville, USA, should have equal access. Our best defense against knowledge being used in a narrow, dangerous way is to allow a broad number of people to participate. I have more faith in humanity as a mass than in any one institution."

Who owns DNA?

There's no guarantee, though, that everyday citizens will make wise use of genetic knowledge when it affects their personal lives. One case history illustrates the point.

Orchemenos is a small village in Greece where many people happen to have a gene that causes sickle-shaped red blood cells. On its own, this gene is harmless – many people of African descent also have it, and it may even provide immunity to malaria. But if two parents both carry the gene, their child is likely to die from sickle-cell anemia.

Clearly, couples should know if they have the gene before they think about having children. A group of researchers tested the villagers at Orchemenos, assuming that carriers would behave rationally and would pair with noncarriers in order to mix the genes safely and protect the community's children. The noncarriers, however, refused to cooperate. Even though the gene was harmless on its own, carriers became stigmatized and noncarriers refused to marry them. In the end, the carriers became a shunned subclass who were forced to marry among themselves, making the situation even worse than before.

Health workers today are extremely cautious about communicating genetic information to parents. Arthur Caplan, director of the Center for Bioethics at the University of Pennsylvania, tells the story of a pregnant woman at a large medical center who was informed by a genetics counselor that her fetus had an extra Y chromosome that might increase the chance of the child displaying aggressive or criminal behavior. Caplan was not particularly happy about the outcome: "After talking about the situation with their family doctor and various friends, the couple decided to abort the pregnancy."

Fetal testing is not yet a standard procedure, but demand for it seems sure to grow as we gain the capability to detect a wider range of abnormalities – and correct many of them before a baby is born. How will parents evaluate this information? If a fetus has a gene that offers a 50 percent chance of muscular dystrophy developing later in life, will the woman carrying it opt for abortion? If treatment for the fetus is possible, but she rejects it and the baby is born with a defect, will she be considered negligent? Does that mean the law will protect fetuses from parental abuse? How will this affect the law on abortion?

Other problems affect only adults, especially in the workplace. "What do you do," asks Michael Gribskov, "if you run a chemical

plant and discover that an employee has an increased risk of getting cancer by coming into contact with chemicals? Do you fire this person? What if his risks are merely doubled, and he wants to stay on the job?"

Such dilemmas seem likely to trigger disputes and litigation that will make other issues raised by technology in the workplace seem trivial by comparison.

But there's more: genetic testing can also be used to discriminate among job applicants. If someone has a heightened risk of obesity, alcoholism, diabetes, or Alzheimer's – and if this can be discovered by quick analysis of a single hair – won't an employer feel tempted to run this test, covertly if necessary? Genetic discrimination eventually may be prohibited by law, but it isn't yet.

Some progress has been made toward the goal of protecting an individual's right to his or her genetic data. Patricia Roche is an expert on public health law at the Boston University School of Public Health. She codrafted a document titled "The Genetic Privacy Act" because, she says, "our primary concern was to protect the privacy of the individual."

A revised version of the text was introduced as a bill in the Senate at the end of June. Roche is uncertain whether this will be voted into law, but 19 states so far have enacted their own genetic privacy or nondiscrimination legislation.

The most fundamental ethical question, though, is far harder to solve. Even if we satisfy the need for privacy and informed consent, are there some genetic procedures that are so inherently unethical they should not be tolerated under any circumstances?

There's been no shortage of committees, task forces, study groups, and agencies wanting to discuss or control genetic engineering. NIH has created the Recombinant DNA Advisory Committee to review proposals for gene therapy. The National Center for Human Genome Research has established a department for discussing ethical, legal, and social implications. Unesco has set up an International Bioethics Committee – and in March 1996 it released a Declaration on Protection of the Human Genome urging that all genetic research should be government regulated, since "the human genome is the common heritage of humanity."

This is a startling concept. In effect, it classifies DNA as a kind of public property. You have the right to control *your* particular version of it, but you may not have the right to change it if the modifications will be inherited by future generations – because this will be altering the overall human gene pool, which belongs to everyone.

Darryl Macer served on the Unesco bioethics committee and is founder of the Eubios Ethics Institute, based in New Zealand and Japan. "It would certainly be in the spirit of the Universal Declaration of Human Rights, Article 27," he says, "to interpret the DNA sequence as something of shared ownership."

Macer hopes the Unesco genome declaration will be adopted by the United Nations General Assembly in 1998. If the United States signs this resolution, Americans could find themselves in the bizarre position of being forbidden by international treaty from making certain kinds of alterations to the seed from which they were created.

DNA could be classified as a kind of public property, because changing it alters the whole human gene pool, which belongs to everyone.

The draft Unesco resolution doesn't rule out somatic therapy, which alters the DNA only in mature cells. Germline therapy is the no-no, since it changes DNA in sperm or ova, and those changes will be passed on to every subsequent generation. Unesco ethicists will grudgingly tolerate this, if it is used only to correct bona fide birth defects. But they adamantly rule out germline therapy to "enhance" future children.

Only one problem: how can we define the difference between a correction and an enhancement?

Customized kids

The situation would be simpler if there were some kind of normal baseline for human beings, with defects lying below this level and enhancements above it. But life is 202 ►

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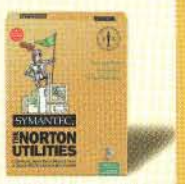

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◂ 201 not simple. Children with a genetic tendency to be obese are likely to die earlier than average; does this mean obesity is a disease that can be corrected in the germ cells, or would that be a form of enhancement? Poor eyesight may be a liability if a child wants to be an airline pilot; should *this* trait be erased from the germline? Should shortness or tallness be considered an abnormality that can be corrected?

Obviously there is a huge gray area between "enhanced" and "corrected" traits, and if germline therapy is allowed, there'll be a temptation to extend it, just as plastic surgery is now often used to enhance breast size instead of merely correcting damage caused by mastectomies.

Fear of this slippery slope has frightened the Council of Europe into proposing a ban on *all* germline therapy in its Draft Bioethics Convention. Likewise, some scientists have sworn a solemn promise never to interfere with germ plasm – sperm or ova – under any circumstances.

Ethicist Caplan is not impressed. He says it's an easy promise for scientists to make, because "none of them believe that anyone is even remotely close to knowing how to alter the germlines of a human being, much less whether germline engineering will actually work." The pledge, he says, is "an expedient way to silence critics."

Caplan feels that germline therapy could be extremely valuable in some cases. At the very least, he says, "some genetic diseases are so miserable and awful that at least some genetic interventions with the germline seem obligatory."

Mark Rothstein, director of the University of Houston Health Law Institute, stated the case bluntly to a local newspaper. "You could argue that it is inefficient to do somatic therapy," he said. "Why not go in there and fix things once and for all?"

Currently, most parents feel they have only two options: allow a fetus to come to term, or abort the pregnancy. Presumably, mothers who rule out abortion on religious grounds would also oppose fetal enhancement, since they would see it as interference with "God's will." But pro-choice groups routinely assert that the fetus is not a person and is part of the mother. By this logic, the mother should be free to change the fetus in any way she wishes – leading to potentially bizarre consequences.

"You see how crazy people get, breeding dogs," comments Jim Ostell. "Does the parent have the right to impose that kind of craziness on children? If you can decide that your son should be 8 feet tall, should you be allowed to make that decision? Frank Zappa had the right to name his daughter Moon Unit, but would he also have the right to give her three eyes?"

Bearing in mind that the debate over abortion has sparked one of the ugliest unresolved conflicts in recent American history, it's not hard to imagine the kind of outcry these capabilities would create.

"Frank Zappa had the right to name his daughter Moon Unit. But would he also have the right to give her three eyes?"

Sequence yourself

Experiments in germline therapy are unlikely within the next decade, and even somatic therapy has been severely limited so far, simply because it costs so much. Most experts agree, though, that the cost of sequencing DNA will continue to diminish, enabling the Human Genome Project to wrap up ahead of schedule and under budget. Will we ever reach a point where it's so cheap to sequence DNA that a consumer can have her genome scanned and stored on a CD-ROM?

This is hard to answer, because the technology is so young. Predicting DNA sequencing costs today is like trying to predict the future of computers back in the 1950s.

Jane Peterson is program director for genomic sequencing at The National Center for Human Genome Research, which allocates $119 million a year for labs involved in the Human Genome Project. Peterson administers grants for large-scale mapping and sequencing. "When the project started in 1990," she says, "the cost was about $10 per base pair." This was clearly prohibitive – there are 3 billion base pairs in the complete human genome.

Thus, one of Peterson's highest priorities has been cost reduction. "It's been coming down," she says, "through better technology and efficiencies of scale, and is now around 50 cents or less. We've recently allocated $42 million for six pilot projects to develop new strategies and technologies that should bring the cost down even more."

Some people remain skeptical. "The ABI multicolor sequencer is the most highly efficient one available today," says Chris Hogue, a fluorescence specialist who now develops 3-D rendering techniques for GenBank. "But it was used right from the start of the project and has not been improved by any new technology that would really bring costs down. Also, it's hard to eliminate labor costs that result from preparing the sample and then reading the output. The raw output has to be rationalized. And scientists need to write commentary. Overall, I think the realistic minimum is 10 cents per base pair using foreseeable technology."

Could atomic-force microscopes "feel" the atoms in a string of DNA?

"This has been tried," says Hogue, "and at least one mistake was published where scientists were looking only at the substrate that the DNA was stuck to. It's really not a simple problem."

Ten cents per base pair may sound modest, but with only 5 percent finished so far, it would still place the cost of the complete sequence at nearly $300 million. Mark Boguski is more optimistic: "When the Genome Project ends in 2003 or 2004," he says, "we should be paying a fraction of a cent per base."

If that turns out to be true, sequencing might be affordable for some individuals 10 or 15 years later. But why would anyone want a copy of his or her own DNA data?

The answer is that DNA is more than just data – it's a program. Once we can read it and interpret it, we should be able to do what anyone would normally do with a program: load it into a computer and run it.

Virtual clones

"Computer models are going to become increasingly complex," says Michael Gribskov, back in his office at the San Diego

Supercomputer Center. "I'm not just talking about models of molecules, but models describing all the interactions within a cell."

Gribskov admits that this is a huge challenge, because so many cell functions are not yet understood. "Still," he says, "we may not need a *complete* model of the cell to simulate the processes." In other words, we should be able to model the relevant processes of a cell without tracking individual molecules, just as we can describe and predict weather patterns without tracking individual raindrops.

When this becomes possible, primary research will no longer require lengthy, expensive lab tests. Instead, experiments will be played out in computer memory, according to rules that describe the ways in which chemicals react with each other. Moreover, using parallel processing, we should be able to follow many of these processes running simultaneously. This would make it feasible to simulate multiple cells as they divide and interact to create a living organism.

At this point science turns into science fiction. Have you ever wished you could have a long-lost relative restored to life? If you have a strand of hair or some fingernail clippings, a simulation is theoretically possible. In the physical world, cloning a person would cause legal and ethical complications; but how can anyone object if you merely use your loved one's data to "grow" a simulated version inside a computer? This would be a whole lot safer, less controversial, and perhaps less expensive than a real-world cloning operation of the type described in *Jurassic Park*.

Perhaps you'd prefer an infomorph of Albert Einstein on your hard drive for those idle moments when you crave a little intellectual stimulation. Einstein's brain has been preserved, but we don't need to dissect and study it – we just need a sample of its DNA in order to grow a perfect virtual replica, with all the same attributes the scientist enjoyed in real life. Of course, an Einstein infomorph will still need to be painstakingly nurtured and educated, mimicking the maturation process of a real human being. But there will be a powerful financial motive for doing this, because as soon as it reaches maturity, the infomorph will be a highly marketable product that can be copied and distributed or rented out on a time-sharing basis. In fact, infomorphs could be the killer app of the 21st century. And remember, we're not talking about cheap, unconvincing AI agents that are merely programmed to imitate famous people. We're talking about a copy grown from the original source.

If we have enough computing power to track all the cell reactions, we should be able to grow a virtual person – call it an infomorph.

Cellular automata programs already create complex and beautiful patterns using elementary math to control the behavior of millions of pixels. Likewise, says Gribskov, computers should be able to track the behavior of millions of cells. At this point it will be feasible to depict, for instance, all the life processes of a nematode – one of the simplest living things.

The implications extend even further. What's to stop us from scaling up from a nematode to a human fetus? In fact, if we have enough computing power to track all the cell reactions, we should be able to grow a virtual person, an information entity – call it an infomorph – inside a computer.

There are trillions of cells in an adult human, but here again simplification should be possible, especially since we would be primarily interested in the brain rather than the body. We certainly won't need to know the position and function of *every* cell to replicate the overall look, feel, and behavior of a human being on the macro scale.

From the infomorph's point of view, the situation might seem a bit grim, being forced to dwell in computer memory and converse with the future equivalent of AOL users. Still, some simulated audiovisual inputs should alleviate sensory deprivation, and the infomorph might be radio-linked with robot rovers if it wants the vicarious pleasure of exploring the physical world.

How much computing power will be necessary to achieve this? Right now, we 204 ►

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Genome

◂ 203 don't even know what we need to simulate a single cell, because information about molecular processes is incomplete. But we know much more about the macro scale. In fact, there have been decent estimates of the power needed to simulate human thought on a real-time basis.

Ralph Merkle, a computer scientist at Xerox PARC, published a paper in 1989 evaluating intellectual processing power. He measured it in three different ways.

Method One: There are about 1 quadrillion synapses in the brain. They process about 10 nerve impulses per second. Therefore the brain carries out about 10 quadrillion synapse operations per second.

Method Two: The human retina (which has its own processing power and is relatively well understood) contains about 100 million nerve cells performing about 10 billion addition operations per second. The brain is bigger than the retina by a factor of somewhere between 100 and 10,000. Therefore the brain must process between 1 and 100 trillion operations per second.

Method Three: The human brain consumes about 25 watts of energy, of which about 10 watts are used directly for mental processes. We know the power consumption of a single synapse and can estimate the average distance between synapses. This means we can figure the maximum number of synapse operations that can be supported by the brain's "power supply." The upper limit turns out to be 2 quadrillion synapse operations per second.

Averaging out these estimates, it looks as if the brain may run at around 1 quadrillion synapse operations per second. How does this compare with computers? We currently have massively parallel equipment that is capable of almost 1 trillion floating-point operations per second. If computing power continues doubling every 18 months, hardware should catch up with brainpower sometime around 2020. At that point infomorphs become theoretically possible.

One element still needs to be considered, though: memory. Human memory seems enormous, since it stores so many sights, sounds, and concepts. How many bytes will we need to replicate it?

Merkle has examined this question in another paper, published in 1994, which tackled the general problem of making an accurate copy of a human brain. First, he asked how much physical detail is important. Do we need to know the position of every brain atom? No. Every molecule? Probably not. The contents of each synapse? Maybe. Research indicates that one bit of memory information is actually stored across thousands or even millions of synapses, but let's play it safe and store the states of all of them.

According to Merkle, if each synapse is described by one byte and there are 1 quadrillion synapses, then we'll need a memory of 1 quadrillion bytes. A terabyte is 1,000 gigabytes, and you can already buy this much memory in the form of optical drives for under $100,000. Clearly it will be no problem for our infomorphs to memorize everything that happens to them in their virtual world. And unlike us, they need not get forgetful as they grow older. In fact, they may never need to die at all.

Again, this might seem quite a stretch, starting from the small premise that DNA is a set of instructions like a computer program. But the chain of logic is unbroken. A human being is a massive system made of cells that interact. When all the functions and interactions of DNA are understood, they can be reduced to a set of rules that determine the way cells behave. If a computer is large enough and powerful enough, why shouldn't it simulate the result of all these rules running simultaneously?

Some people may feel tempted to store and run simulations of *themselves*, thus achieving an ersatz immortality. Picture Joe User in 2070, sending a tiny skin sample by FedEx to a mail-order sequencing lab. A couple of days later he receives his complete DNA sequence via email. Now all he needs is a computer and the necessary software to grow a copy of himself, much as people today keep tropical fish.

Joe's too busy to be a full-time parent, so he hires an online nanny service that maintains its own infomorphs to educate young virtual clones. This is a huge advantage, since the info-entities can communicate at their own accelerated speed, shortening childhood to a matter of months. Within a year, Joe Jr. is up and running as an adult. Now Joe Sr. can preserve all his adult memories by copying them into his virtual self. Extracting synapse states from his brain would be impossible by any method currently known, short of a gruesome and destructive freeze-and-peel operation. But nanotechnology, for instance, might make it work, and as a result, Joe's life knowledge and experience would be permanently preserved. His children's children would be able to talk to Joe Jr. anytime, long after Joe Sr.'s physical self has died.

But why should Joe Sr. remain a hostage to his mortal physical body? Why not copy his entire self into the virtual world, and say adios to meatspace?

This is so speculative, it's hard to view it seriously. Still, a deadly serious subtext remains: when we can describe the fundamental seed of a human being entirely as computer data, our whole conception of the human condition starts to change. When bits accurately represent DNA, those bits literally become a life-form of their own, and physical biology looks increasingly primitive by comparison.

Related Links

NCBI homepage, links to GenBank, and sample DNA data (you can download actual DNA sequences here): *www.ncbi.nlm.nih.gov/.*

Most frequently used links to genome-related Web sites: *www-ls.lanl.gov/HGhotlist.html.*

Eubios Ethics Institute: *www.biol.tsukuba.ac.jp/~macer/.*

Department of Energy primer on fundamental concepts of genetics: *www.gdb.org/Dan/DOE/prim1.html.*

The National Biomedical Computation Resource at the San Diego Supercomputer Center: *www.sdsc.edu/nbcr.*

Entrez, the searcher/viewer program for GenBank, is available via FTP from *www.ncbi.nlm.nih.gov* (130.14.25.1) in the entrez/network directory. Entrez comes in versions for Mac, PC, and Unix, and allows access not only to the genetic database but also to 1.2 million linked citations in Medline. A network version, compatible with Netscape and Mosaic, has built-in graphics capability and can be downloaded from the NCBI Web site.

Free DNA

The specter of genetic modification has spawned endless government reports, blue-ribbon position papers, and international

resolutions. Doomsayers such as Jeremy Rifkin are already carving out a steady income denouncing the whole field of modern genetics.

Yet all the edicts and opinions may ultimately be irrelevant if the demand for DNA sequencing and gene therapy causes costs to diminish to the point where techniques are accessible to individual consumers. At that time, even scientists and doctors are liable to find themselves out of the loop.

Diagnosis will no longer entail physical examinations, expensive tests using large pieces of hardware, or the physician's traditional educated guess based on the look and feel of a patient. Drugs will be precisely targeted, avoiding dangerous side effects. Surgery may still be needed for some conditions, but much less often.

Smart sensors driven by expert systems will diagnose abnormalities. Automated treatment systems will be mass-produced as consumer products, in much the same way that blood-pressure sensors have become an off-the-shelf item. Genetic drugs will be highly specific and therefore extremely safe, allowing you to modify your DNA in the privacy of your own home. And if the FDA doesn't approve, Americans will likely turn to foreign sources of supply, just as AIDS patients do today.

Thus, the system of government controls and conventional medical ethics will be loosened, and individuals will be able to start making their own decisions. Some may choose to do nothing at all, which is plausible considering recent findings that show a majority of Americans believe any tampering with DNA to be against the will of God. But if parents have a chance to protect their children from a crippling defect, how many will just say no to genetic therapy? If they can make a child stronger or healthier or more intelligent, won't they feel tempted by this, too? And when genetic data is as cheaply and easily available as computer data, won't we all start to look at life in a more pragmatic, less reverential way?

Whatever people choose to do with genetic data, it's becoming clear now that human beings consist of information.

Perhaps greater personal power and freedom will ultimately inspire a new set of ethics to guide individual behavior. Alternatively, we may see companies calmly and coldly manipulating genetic data in order to market new life-forms, from customized pets to infomorphs.

Either way, whatever people choose to do, it will be very difficult to stop them – because it's becoming clear now that *human beings consist of information.*

And, as everyone knows, information just wants to be free. ■ ■ ■

Talk with author Charles Platt live Thursday, January 9, at 1 p.m. PST at *www.wired.com /5.01/genome/.*

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Shaw

◂ 156 singled him out for a walk-on role in the Tom Hanks film *Punchline*.

"Great suit. Perfect for the part," said the casting director, draping a woman on Shaw's arm and telling him she was his wife.

Shaw spent the rest of the night shooting one scene over and over again. Hanks is watching their taxi arrive at the club. Out jump Shaw and his wife.

"Sir, did you tip the cabbie?" inquires Hanks. "You cheap bastard, tip the cabbie!" he yells at the well-dressed, fast-moving Shaw.

When they broke at dawn for breakfast and Hanks discovered he had been playing his scene with a real investment banker instead of an actor, he cracked up laughing. The director, on the other hand, went apoplectic. Shaw's scene was cut from the movie, probably for want of a union card (which Shaw didn't get until later, when he played another bit part in *Dangerous Love* with Elliott Gould).

Shaw poked his nose into every aspect of Morgan Stanley's business, pestering colleagues with questions and suggestions on how they could do their jobs better.

"He is personable, but intense," says a former colleague. "He drills down on questions and won't let them go. This is great, if you're willing to die for the answer. But if all you want to do is get on with business, it can be a pain."

Shaw is more blunt: "I got on people's nerves."

RIP: tassel-loafered leeches

After a year and a half at Morgan Stanley, Shaw struck out on his own. He founded D. E. Shaw & Co. in 1988 in a loft over a communist bookstore near Greenwich Village. The company had six employees and $28 million in capital invested by Donald Sussman and three of Sussman's friends. Sussman runs Paloma Partners, a $1 billion fund-of-funds in Greenwich, Connecticut. He's a high net worth individual, as they say on Wall Street, and a tough cookie. Sussman on the telephone sounds as if he's growling out answers to my questions while simultaneously reading *The Wall Street Journal*, watching his Bloomberg box, and trading Euroyen futures in Zürich.

"Why did you decide to invest in David Shaw?"

"He's the smartest person I've ever met. I'm lightweight compared with him."

"But you're richer than he is."

"So what if his fund is now smaller than mine? By the end of our lifetimes his net worth will vastly exceed mine."

During Shaw's education at Morgan Stanley, he decided pairs trading was not going to be the way he would make his fortune. Instead, Shaw's secret is algorithmic trading, a complex financial juggling act that exploits tiny price differences between multiple international markets. Maybe the stock of Sun Microsystems is selling for $50 in New York and $50.50 in Hong Kong. This is called a market "inefficiency." So you buy low in New York and sell high in Hong Kong and pocket the difference.

"We follow the same principles as the CIA or NSA. Information is partitioned off and distributed on a need-to-know basis."

Such discrepancies don't last long. With computers and communication links spreading market information everywhere in nanoseconds, these price gaps tend to close almost as fast as they open. You also have to juggle currency exchange rates and transaction costs. To play this game, you have to be quick and surefooted.

Which Shaw always seems to be. He makes his bets with the aid of mathematical models whose exact nature is more closely guarded than the recipe for Coca-Cola. Until April 1996, when Juno was launched and Shaw had no choice about developing a public persona, he rarely let visitors inside his company. The few details that leaked out were a bit scary: Shaw was a control freak who kept his own traders in the dark about how the firm's computer models worked.

"We follow the same principles as the CIA or NSA," Shaw says of company security. "Information is partitioned off and distributed on a need-to-know basis." When asked if he used neural networks to design his trading strategies, Shaw said, "I could tell you, but then I'd have to kill you afterward." He was joking, I think.

Once Shaw got his hedge fund running, he realized he had enough computational models and machines to branch into other businesses. He moved into basket trading, where you buy billion-dollar stock portfolios from big investors who want to unwind their positions in a hurry. He also moved into something called the "third market." This is automated, off-exchange trading of listed stocks. Volume on the third market is already 15 percent as large as that on the New York Stock Exchange, and Shaw is well positioned to get a big chunk of this business.

Stock trading for Shaw is nothing more than a network in which computers match buyers and sellers and store unfilled orders until the next customer dials in. Order flow is key.

But unlike market makers on the major stock exchanges, who charge money for the finger-wagging and yelling required to fill your order, D. E. Shaw pays money, between one and two cents a share, to brokers who send them their business. (They make their money not on commissions, but on the spread, the difference in price between buy and sell orders.) You now know why the cost of stock trading at your local cut-rate brokerage firm is falling through the floor.

"I find a lot of finance highly amusing," says Shaw. "There's a lot of hocus-pocus practiced by people with fancy suits. Quite often they're selling you financial products that are terrible deals or providing very mechanical services at inflated prices."

One such group of fancy suits are the market makers, specialists, and brokers who run America's stock exchanges. "Many of them are doing something that should be done by computers," he says. "It's just not very complicated. All 210 ▸

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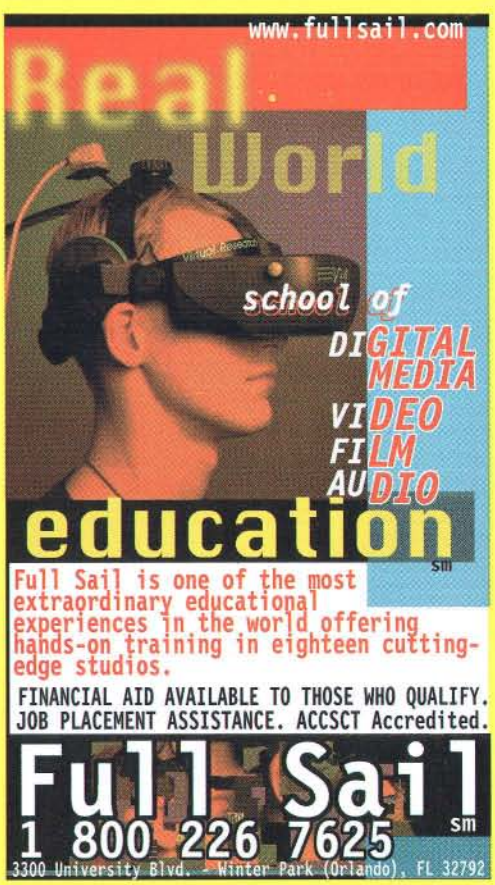

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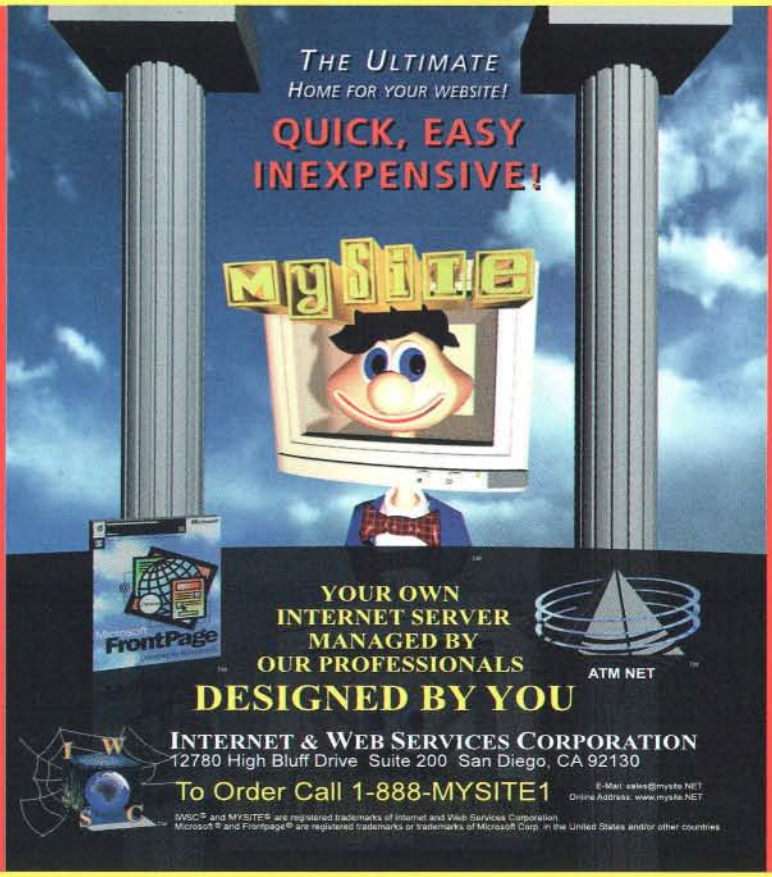

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Shaw

◂ 206 you have to do is match a buyer and a seller. In serving this middleman function, you collect exorbitant amounts of money for a very simple process."

In Shaw's view, once computers have replaced these tassel-loafered leeches, a new financial era will dawn. Shaw calls this the golden age of "disintermediation," because it involves "pulling intermediaries out of the loop and letting customers get closer to each other."

He envisions the possibility of an Internet exchange in which market makers no longer pocket hefty fees for matching buyers and sellers. No longer will investment bankers suck up 6 percent of the capital raised when companies sell stock during initial public offerings. "In the long run, people shouldn't have to pay us or other Wall Street firms as much as they do for many of the services we provide," says Shaw.

Shaw admits that his visionary ideas, if carried far enough, might put him out of business, at least the market-making business. But he calls this "a historical inevitability."

Shaw occasionally assembles his staff and exhorts them to think about the financial future: Internet markets, disintermediation, crossing networks that allow people to trade with each other directly. "What we are doing now is not the end product," he declares. "Let's try to imagine what things will look like 10 years from now. Is there some way we can leapfrog into the future, without losing our shirt in the process?"

In recent years, Shaw has become increasingly bold in his investments and has moved into venture capital. He has put money into two companies researching new ways to design drugs. Shaw thinks the old method of drug design, by a laborious process of trial and error, is as outdated as traditional stock trading. "It may be my computer science prejudice," he says, "but as soon as you learn the rules of the game, you realize the right way to do this is mathematically, as opposed to grinding and mixing things in test tubes."

Shaw's preference for redesigning the world from the ground up has been applied to his Internet activities as well, including Juno. Although the company has been weak on the revenue side (advertisers are just beginning to climb on board), Shaw says he is carrying on an "incredible program of experimentation. We watch over the shoulders of paid experimental subjects by trapping their inputs and looking at all the places where they make mistakes," he says when describing the process of designing the system. "Then we experiment with moving buttons around or changing their colors, which results in a dramatic drop in errors."

Good design is a critical factor for Shaw. Another environment bearing his signature is D. E. Shaw's headquarters, which moved in 1992 to the top two floors of a skyscraper near Times Square. The D. E. Shaw company logo is inspired by an electronic switch, and its office, with its shiny black floors and cutout walls bathed in reflected light, is meant to evoke the feeling of sitting inside a computer chip.

The office, with its shiny black floors and cutout walls bathed in reflected light, evokes the feeling of sitting inside a computer.

D. E. Shaw's stock trading room is a gear-filled, black hexagonal chamber that makes the *Challenger* space capsule look antiquated. Shaw sits at a brushed-aluminum, wing-shaped table ergonomically designed so that his neck swivels no more than 15 degrees between computer monitor and desk surface.

The icy atmosphere belies Shaw's populist sensibilities. In this cynical age, I may be faulted for believing, but I think it true, that Shaw has other motives besides money for offering the world free email. His political work for Clinton has convinced him more than ever that there is a growing gap in the United States between the digerati and the computationally illiterate – a gap that ultimately threatens to cripple the country's productivity.

While Shaw is providing free email to everyone who wants it, including inner-city residents and hard-to-wire rural customers, he is simultaneously pushing the larger political agenda that will get every classroom in the United States wired into the Internet.

"From a business viewpoint, it's not ideal to offer free email to subscribers who aren't demographically appealing to advertisers," he says. "But even if we don't make any money on these subscribers, I think for political and social reasons it has to be done.

"I actually believe that technology, including email, can be harmful if it serves to drive a wedge between information haves and have-nots," says Shaw. "Even if we get parity of computer access within the schools, we're still seeing an incredible gulf in terms of home access to computers, and this gulf is now beginning to show up educationally."

Juno is free in the sense that network television is free. In exchange for the connection, a subscriber gets targeted by advertising, and soon subscribers will get targeted by D. E. Shaw, which wants to lure them into using its online financial service, FarSight.

Despite FarSight's lofty ambitions, it needs to clear some formidable hurdles. "D. E. Shaw has little experience dealing with consumers or partnering with financial behemoths," says Forrester's Gómez. "And it also remains to be seen how a company whose stock-in-trade is secrecy will interface with online investors."

Fidelity Investments, E*TRADE, and Charles Schwab are already selling stock online, while bankers from Citibank to American Express are creating "thin branches" as fast as they can. But the World Wide Web may, in the end, prove no match for Wall Street's very human, and very hard-selling brokers. The trick to the success of FarSight, like Shaw's other ventures, will be extreme integration, efficiency, and ease of use. "For all we know, they might be able to 211 ▸

Colophon

***Wired* is designed and produced digitally.**

Our thanks to the makers of the following:

Hardware

Apple Power Macintosh and Power Computing PPC personal computers; PowerBooks and PowerBook Duos; Apple Work Group Servers; Agfa Arcus II, Select Scan Plus and Vision 35 scanners; Portrait Pivot 1700 Displays; Radius Precision Color Displays, Precision Color Calibrators, VideoVision, PhotoBooster, Thunder IV graphics cards; Apple LaserWriter 16/600s and color 12/600s, Hewlett-Packard LaserJet 5si and 4mvs, Tektronix 480 color printer, Xerox Regal 5790 digital color copier/printer; APS, MicroNet, and La Cie storage media; MicroNet DDS-2 DAT drives and auto-loaders; Pinnacle Micro Sierra 1.3-Gbyte MO drive; US Robotics Courier, Motorola Power Series, and Global Village Platinum modems; Sagem and Motorola BitSurfr Pro ISDN terminal adapters.

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New Year's resolutions: become emancipated from my therapist; build a cave in my backyard; don't believe the hype; eat more gummi-type foods; go to Hong Kong before July 1997; have a drink a day; kill my computer; kill my TV; leave no fingerprints; never buy a car built after 1967; no more heat 'n' eat frozen pancakes; own every *Flintstones* episode on video; think fast; write a novel.

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Shaw

◂ 210 come in and reinvent this thing from scratch," says Gómez.

Visitor from parallel universe

We have spent the day talking, and Shaw looks as if he could go all night. But the dinner bell interrupts.

We walk into the dining room to find Shaw's party already seated. Famished, I plow into my lemon-spiced, undercooked broccoli, until I am brought up short by the comments of Shaw and his friends, who find the spa cuisine ludicrously inadequate. A guy who tolerates zero human error in his stock trading wants zero fat in his dinner. The table is stripped bare of salt, sugar, butter, wine, coffee. But what's that dry hunk of sesame chicken doing under my broccoli? Do I know how much saturated fat there is in a piece of chicken? Soybean burgers and soybean hotdogs, that's what I should be eating!

"Don't forget the red wine," I remark. "You know, for keeping down your cholesterol."

My comment provokes Shaw into a lecture on cholesterol, in which we learn about the latest medical findings concerning the difference between lipoprotein, a form of LDL, or bad cholesterol – which gloms onto blood vessels and for which there is no known treatment, except, possibly, vitamin C – and HDL, which is actually a good kind of cholesterol responsible for reducing the risk of heart attacks.

"Everyone in the family consults him for medical advice," Shaw's wife tells me, and I begin to understand why some of his venture capital investments center around drug research.

As Shaw bears down on his topic, giving us the latest *Journal of the American Medical Association* findings on the subject, I get the sneaking suspicion I'm sitting next to someone who looks like a human being, and who plays the role quite convincingly, but is actually a visitor from a parallel universe.

Everywhere Shaw gazes he sees that we humans have made a mess of things. With wonderful good humor and efficiency, he is offering to help straighten it out with a wave of his computational wand. He wouldn't want to be president of the United States, Shaw told me. The pace of government is too slow, and it involves too many compromises. But I get the idea he wouldn't mind being president of everything else.

The following morning, after eating a bowl of wheat-berry gruel, I make my goodbyes and drive out of town, heading for the most high-fat, megacaloric, wine-drenched lunch I can find. On the way I keep thinking about money and the way it presents itself to people like Shaw. It's an amusing game. Money is really just a puzzle, a way of keeping score. It's revelatory about people's personalities and preferences. But in the end, it's just another form of information, which can be reduced to bits and bytes and zapped around the world at the speed of light. If one sits in the middle of this information, processing it, routing it rapidly from point A to point B, the view from this central vantage point is ever changing and always fascinating.

Shaw sees that we humans have made a mess of things and is offering to help straighten it out with a wave of his computational wand.

"Sometimes I think I'm going to wake up and discover there's been a clerical error – that we're really losing millions of dollars instead of making them," says Shaw. "Then I pinch myself and get back to reality."

Shaw describes the various people who have offered to buy him out. "'We'll never sell the firm,' I tell them. 'That's not in the cards. It doesn't matter what the price is.'

"'Oh, come off it,' they say. 'Everyone has a price. Would you sell for $5 billion?'

"'No,' I tell them. 'My lifestyle wouldn't change if I had more money. This is the most fun I've ever had.'" ■ ■ ■

Message 43:
Date: 1.1.97
From: <nicholas@media.mit.edu>
To: <lr@wired.com>
Subject:

Surfaces and Displays

Joe Jacobson, coauthor of this article, believes that paper is a medium for the future. A medium that will build on its current ubiquity, but in an exciting and revolutionary way.

How important are paper and ink in today's world? One in seven US patents makes mention of either paper or ink – more than make mention of any type of electronics! Hard to believe? Look around your office or home and count the number of items that have some form of print on them, then compare that with the number containing chips.

The phenomenal readability and economy of printed ink on paper compels us, even in the digital age, to mark our behavior in this age-old manner. There is no lag when going from page 1 to page 44 of a book and then back to the appendix. So, too, with a newspaper. The presentation is immediate. No start-up, no logon, no button click, just paper where and how you expect it. Ink is great because every page and object gets its own. You don't have to go to a special corner of your desk to see ink. It's everywhere.

Ink is great because every page and object gets its own. You don't have to go to a special corner of your desk to see ink. It's everywhere.

Electronic ink

One disadvantage to ink is that it's tough to erase. What we need is electronic ink that can be printed as freely onto as many different surfaces as traditional ink, but that is electronically mutable. It should be able to get up and walk away and change its shape, color, or intensity.

Joe's ink can do all this. His secret takes a page from carbonless paper. The back of carbonless paper has a thin coating composed of tiny capsules filled with clear ink. These capsules, about 1 million per square inch, are then broken with the pressure of your pen. When the clear ink oozes out the back, it chemically changes a colored ink on the page underneath.

Now, put that thin coating on the front of the page, and instead of putting ink in those capsules, imagine stuffing them with ping-pong balls one one-thousandth of their normal size, black on one side and white on the other. Then add some lubricant. Assuming you can control the rotation of the contents of each capsule – independently, electronically, and with the knowledge of where it's facing – you have electronic and reusable paper.

Given that the flat-panel display market is US$30 billion per year and growing, Joe is not alone in his quest. Enormous energy and thought is being given worldwide to making better computer displays. The current standard is the thin-film transistor LCD. It draws 2.6 watts, costs about US$1,000, and is constructed on glass. TFT displays are expensive because their million or more transistors are spread over the large screens. They consume generous amounts of power because the TFT backplane eats about a watt, as does the required backlight (transmissive LCDs let through less than 20 percent of the light). Because of the glass sandwich they are packed in, LCDs are not as rugged and cannot be used as flexibly as they should be. Technical improvements can still be made, and electronics companies around the world are investing billions of dollars in research and manufacturing facilities to do so.

So, how can Joe compete with these deep-pocketed giants? Simple: he looks at the problem differently. It's not a display he is building. It's ink. The advantage of his mind-set is that ink is more general than paper. It can go on almost anything, and it's cheap. To make a display, just add a grid of addressing lines – which, by the way, is just another type ink (of the conductive variety) – to control the behavior of your e-ink.

Paper comes alive

Once you've got working e-ink, there is nothing to stop you from binding several hundred e-pages to construct an e-book worthy of the name.

Coming from the flat-panel LCD point of view, one would never envision an electronic book containing hundreds of displays. It would be much too heavy, too power hungry, and way too expensive, not to mention fragile. But e-ink gets you there. My grandchildren and Joe's children may carry around a single volume containing a whole library of books whose pages are used over and over again. No other book would be required.

But let's go one step further. When your printer is loaded with conductor e-inks, you need not stop at books. Everyone agrees that shipping newsprint is absurd. Yet few people read their news on a screen (I may be one of the few). In general, the screen is not in the right place – you are forced into a specific position and cannot always take the monitor with you. What screens do allow is easy change, be that video, personalization, or up-to-the-minute news. Not a new concept, by the way.

When Thomas Edison was 14, he set up his famous printing press in the baggage car of Port Huron's *Grand Trunk Express*. He received the daily news via telegraph, which he would then typeset and distribute as an up-to-the-hour newspaper on the train ride to work. The same thing can be done with e-ink.

Radio paper

It turns out that the conductive inks used to make e-paper can function as radio antennas. Other inks used in e-paper can be turned into radio transistors. This makes "radio paper," which can be as thin as notepad stock and sit on a coffee table or in your pocket, receiving FM news broadcasts. It "typesets" itself – every hour or day – with the latest news. With e-ink, a single piece of paper displays the news for years.

By extension, any surface can now be modified into a display. Wallpaper of the future will be sold by the gallon in one customizable color, billboards will be painted once, wine labels will tell you when to drink the bottle, T-shirts will be watches, and our trees might live a little longer. ■ ■ ■

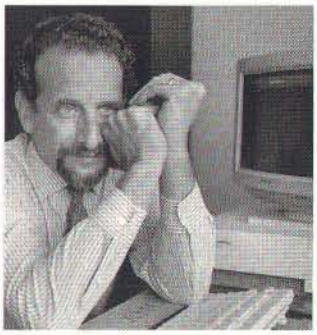
This paper was coauthored with Joe Jacobson, assistant professor of µMedia at the MIT Media Lab.

Next Issue: Pay Whom per What When

Larry Bowdish, Publishing Executive, 37; of Massive Hard Drive Failure

By SIMON BOWDEN

He was the envy of the textbook publishing crowd. The bad boy of the scholastic set. Witty, urbane and outspoken, Larry Bowdish lit up a sleepy industry with his meteoric rise to the top, but the ride ended suddenly late one night last week, when he suffered a devastating system collapse during final manuscript edits.



Larry Bowdish

Mr. Bowdish's sudden demise came as a shock to his friends who recalled a man known for his boundless energy, determination, and enthusiasm.

"Naturally, we're all a little stunned," said Information Services Director David B. Cohen, "after all, we encourage employees

"One minute you've got the world by the tail and the next...you've been erased."

to save their work every chance they get." Said another colleague, who asked not to be identified, "It's so unfair. I mean, one minute you've got the world by the tail and the next...you've been erased."

"A team of experts have traced the system collapse," said Mr. Cohen, "reconstructing Bowdish's last hours and his desperate attempts at retrieval." It now appears Mr. Bowdish was downloading from corporate archives onto his workstation, and periodically dumping onto floppy disks. "People can use floppies as backup, but obviously there's limited capacity. Besides, Bowdish was making changes straight onto the disks, not even keeping track of his changes. So, searching for lost data became a moot point," explained Cohen.

The controversial Mr. Bowdish combined a flair for the dramatic with a keen sense of publicity, not always welcome in the somewhat conservative milieu of textbook publishing.

Mr. Bowdish, who had no known history of hard drive failure, leaves no surviving software. In lieu of flowers, the family kindly requests all leads and reasonable job offers be forwarded to the home address.

Nancy Conaty, 34, Accidentally Trashed by Four-year-old Son

By SIMON BOWDEN

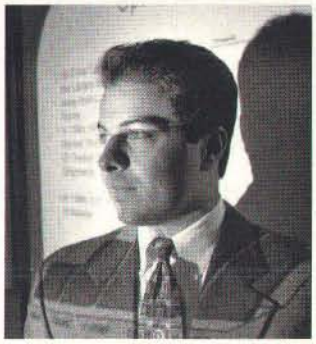
Mrs. Nancy Conaty was sole proprietor of an executive search firm run out of her home. The end came in a tragic family accident late Thursday afternoon. Mrs. Conaty had gone into the kitchen to check on a pot roast when son Joey dragged her unsaved document into the trash, then pounded unknown commands on the keyboard.

The computer was rushed to a neighborhood computer store where specialists struggled frantically for hours to retrieve the work. Their attempts were in vain. The damage was too widespread. "Had this occurred with a safe backup in place, no big deal," the store manager shrugged. "But there's very little we can do in a case like this."

Friends of the bereaved declined comment. Joey has been keeping a low profile, playmates said.

Mysterious DOS-Based Virus Claims Famous Accountant

By SIMON BOWDEN



Stephen Cunningham

Stephen Cunningham, known affectionately in accounting circles as the Bulldog of Due Diligence, was found not at his desk yesterday morning.

His untimely exit from his usual post coincided with the discovery of corrupted files on the largest acquisition in the history of his firm. It is not known whether the data disappearance alone caused Mr. Cunningham's departure. But sources revealed that the ex-Senior Vice President's lengthy battle with a mysterious DOS virus was well documented within the firm.

"The guys from Tech Support were down here all the time," claimed long-time assistant Jane C. Deery. "Steve was always getting these weird system bombs. But he had such an amazing memory he was usually able to re-create what was lost. I've never seen anything like it." It remains a mystery as to why the departed simply didn't back up his hard drive.

Ms. Deery added Mr. Cunningham declined the traditional going away party, wishing instead to "just get on with things."

Web Designer Gary Stepniak, 24, Burglary Victim

By SIMON BOWDEN

The computer graphics industry was saddened yesterday to hear of the loss of Gary R. Stepniak, President of Internet startup Steptooniaks.

Mr. Stepniak's laptop was stolen in a weekend break-in. There are no surviving files.

"Everything was on there," lamented Blake Olson, Mr. Stepniak's partner. "Basically, we're screwed." Close business associates and the firm's few remaining clients believe that, had Mr. Stepniak simply purchased an external back up drive, Mr. Olson would not now find himself in the painful and somewhat embarrassing position of explaining his ex-partner's tragic blunder.

Mr. Olson wishes to express his heartfelt appreciation for the tremendous outpouring of support and condolences offered from the design community.

"Make no mistake. We're still in business despite everything," insisted an obviously distraught Olson, "No doubt, this is a great loss for the company. Of course, we'll miss Gary, too."

Crashes

Churbuck, Megan

Esposito, Lori

Hornick, Amy

Lewis, Stephen

Noble, Joanne

Rauscher, Stacey A.

Svizzero, Ron

ANESER, Richard J. of New York City. Desktop computer, aged 3 years. Software included spreadsheets, word processing, and a graphics program as well as a promising screenplay, his son's book report and other documents for business, personal and family use.

Crashes

BEATTIE, Maureen of Seattle, WA. Losses included a powerful new desktop PC with 8k RAM, built-in hypercard modem, undetermined and customized software. For complete listing, see today's classified advertisement section under 'Computers and Office Equipment For Sale.'

CHARTRAND, Cindy, 36, of Castaic Juneti, CA. Born July 15, 1960 in Manchester, New Hampshire. Mother of Andrew and George. Survived by brothers Errol and Peter, dozens of friends and relatives, plus several erased and useless disks.

Crashes

DOWNES, Laura. Late of Medford, MA. Beloved ex-small business owner, wife of Jack, mother of Shannon, Timothy, Jr. and Elizabeth. Survived by scores of customers, suppliers, tax attorneys, accounts due, and accounts payable. Your records will be missed by us all.

SILVERIO, Guy, aged 41, of Dallas, TX. Travel agent whose system failure meant the loss of confirmation codes and customized itineraries. Survived by scores of travellers stranded in unknown locations around the world, including his wife and daughter who relatives think are somewhere in Greece.

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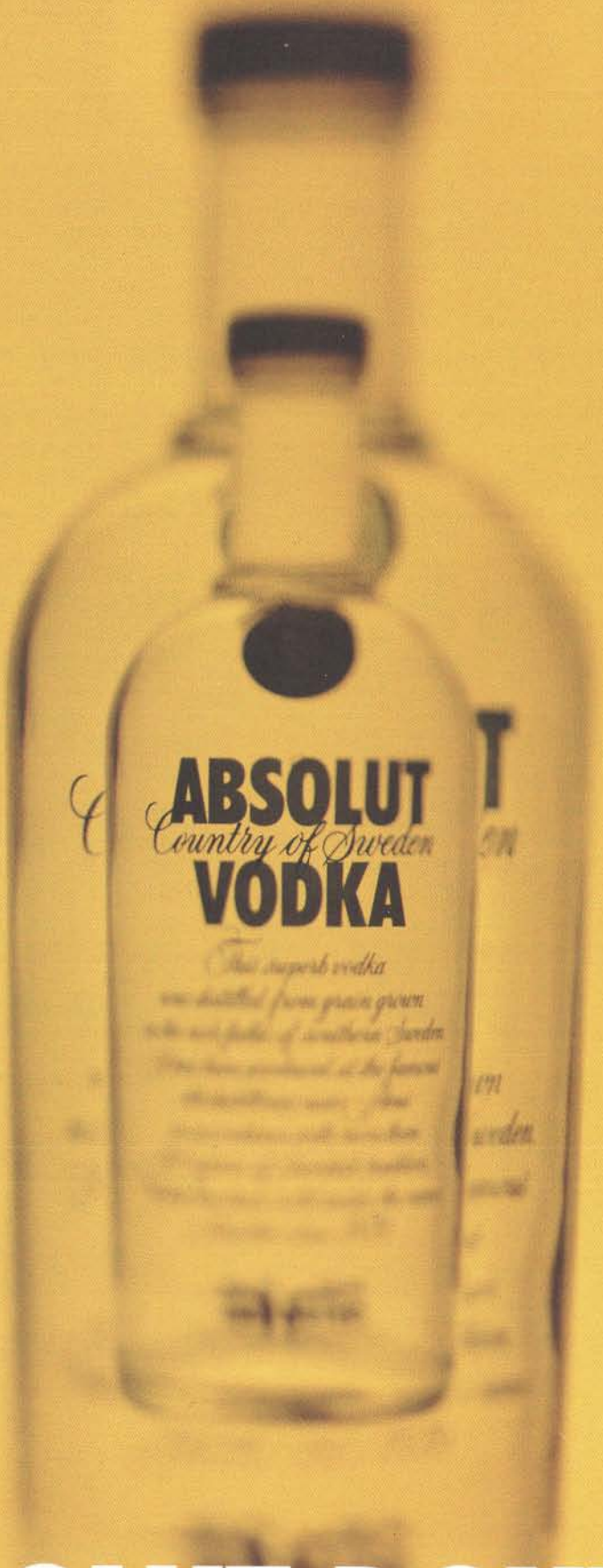

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